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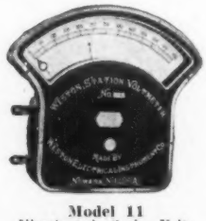

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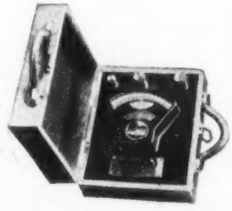

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The Federal Water-Power Act

THE country is indeed to be congratulated on the final enactment of the water-power bill which in various forms has been before Congress for the last eight years. The story of the vicissitudes of the bill is a striking example of legislative inefficiency under the shifting pressure of warring factions and clashing interests. At last the bill is law, and the thanks of the country are due to those who have consistently fought to secure its enactment. Opposition was due to various forces, some of them raising debatable questions as to the rights of the states, others based on socialistic propaganda, and still others having their origin in the bogie of a water-power trust. As we have repeatedly pointed out, there is not, and never was, any such thing as a water-power trust, but only a growing recognition on the part of banking interests of the value of hydro-electric development as an investment looking to the future of American industries. Certainly the government will have it fully within its power through its commission to see to it that no menace to the public shall spring from this appreciation of values. In the actual working out of water-power development under this act the Federal Power Commission has almost plenary authority. It is composed of the Secretaries of War, the Interior and Agriculture, the three departments whose activities are most closely touched by the law. As a working body the efficiency of the commission will largely depend on the executive secretary and his staff, operating under the guidance of the Cabinet members named. It is just here that we hope the government will give the commission a very free hand to secure the best expert advice obtainable, for on this will hinge the ultimate success of the movement. The commission is charged with many administrative, constructional and financial duties which require a close detailed knowledge of hydro-electric propositions. The general provisions of the bill are sound and the practical difficulties will be those due to detail. One of the questions which involve some very nice adjudication of authority is the division of powers between the federal commission and the commissions of the several states. The interstate relations of the larger transmission systems have already come in for serious consideration, and as the plants develop under the provisions of this bill the situation will become more complicated. Especially will this be the case when and if the United States takes over part of a somewhat generalized project and has to determine equitably both net investments and the severance damages.

Such questions as these are, of course, for the future rather than the present, but they point out the necessity of a commission carefully and thoroughly organized for very intricate and varied activities. The important thing just now is the great step that has been taken in freeing vast amounts of water power for immediate development. At this time, when the fuel situation is monthly growing more acute, especially from difficulties of transportation, the help available from water powers is of vital importance, and the government cannot act too quickly in organizing the commission and laying the groundwork of something more than a local and limited system of distribution. The time has come for working on a large scale with a broad view of the industrial needs of the country. Our most earnest congratulations to the wise and far-sighted legislators who have seen the needs of the country and joined in putting through what promises to be one of the great constructive projects of the nation's history.

An Outgrown Point of View

A VIEW on public commission regulation expressed recently by the president of a prominent public utility company in the South, that the commission "may be likened to a board of arbitration every member of which was appointed by the other side," doubtless expresses what appears to him the attitude of the body with which his company has to deal, but it is a view that will not bear close analysis. Public service commissions are not boards of arbitration appointed by the public to settle disputes between itself and the utilities. They are to all intent and purpose permanent judicial bodies, and no more than other judges, who are also either elected directly by the people or appointed by those who are, do the commissioners come into court with minds prejudiced for plaintiff or defendant. We do not mean to say that always and everywhere the proceedings of public service commissions have been in accordance with this statement, but simply that this is the theory that naturally dominates their creation and their hearings. To dwell on the threatened public predicament of utilities starved to death and citizens without service, as was done both by the official alluded to and by the director of the Federal Reserve Bank of Chicago in recent public testimony, is to paint a picture lacking in verisimilitude. Not cessation of service but public ownership and operation is the alternative to the inability of an essential utility to function. To render service of such excellence and in such spirit that this alternative will gain no support is the problem of the public service companies. Every consideration of justice and public expediency demands that in return for such service the properly managed and financed utility shall make an adequate profit. We believe that citizens everywhere can be brought to realize this where they have not already done so, but to expect that rate fixing will ever revert to the control of company executives would be vain.

Utilities Must Convince the Public of Their Service Ideals

CONSERVATIVE ideas and the traditions of a bygone day in public utility management unfortunately persist to the disadvantage of the utilities in dealing with present-day problems. No matter how honest or well meaning a business man may be, the major part of his success depends on his ability to imbue the public with a thorough understanding of his honesty. Only in this way can a basis of mutual confidence be established. A public utility depends on the confidence of investors for its ability to finance and therefore to perpetuate itself. The confidence of the investor is in turn based on the confidence of the public, on which the utility must depend for its profits to attract the investor.

The management of a public utility is therefore under as urgent a necessity of bringing the public to realize its honesty as any other business, and inherently it has a more difficult task because competition cannot be made the factor that it is in the ordinary business undertaking. Public utilities have too often concealed entirely legitimate and honorable policies behind a veil of secrecy for which there has been no excuse other than a fancy that the average run of human beings cannot be trusted to face facts. Under such conditions petty politicians have made the best possible use of this policy of silence and have told their story loudly and at length, with the result that the service ideals of the public utility are not always understood. For this condition public utilities are largely at fault.

The solution is in broad-gaged publicity. No specific rules can be laid down to fit all cases. Each instance must be met and handled in accordance with existing conditions, but one thing that is needed is the placing of the facts regarding utility work before the public vigorously and effectively. Since the basis of real publicity is mutual confidence, until the utilities are able to bring this about suspicion must persist to hamper utility financing and development. Frank and fearless telling of the facts is one of the effective methods by which service ideals can be impressed upon the public.

Some Phenomena of Arc Welding

SOME extremely interesting details regarding the transfer of metal which occurs in arc welding are given by O. H. Eschholz in this issue. He points out that there may be three somewhat distinct causes for the flow of metal across the arc. First, there may be complete vaporization of the metal and its transport into the arc stream; second, the occluded or generated gases in the electrode ends may blow out a certain quantity of liquid metal, and finally this may be transported by the ordinary molecular forces that cause surface tension and adhesion of one substance to another. Experiments carried on to determine the source of metal flow lead Mr. Eschholz to believe that the cause last mentioned is the really effective one.

Vaporization is barred, as anything more than a contributing cause, by the fact that the energy put into the arc is very much less than is sufficient to account for the vaporization of the amount of material which actually goes over. The whole energy spent in the arc is only a modest fraction of that required to vaporize the necessary amount of iron. Mr. Eschholz estimates that of the total energy required per pound of electrode carried away about 60 per cent goes into liquefaction of the material, approximately 26 per cent into vaporization of some portion of this liquefied material and about 14 per cent into ordinary thermal losses. The effect of gas expansion in forcing the molten metal away from the electrode is at times noticeable, but is often pernicious in its effects. The normal operation of welding seems to require that the effect of occluded gases should be very modest. This by a process of exclusion leads to listing the ordinary forces of surface tension, adhesion, and sometimes gravity as counter effect, as the active forces in the transfer of metal.

This view is strongly borne out in Mr. Eschholz's photographic study of the process of metal transport. Most of it seems to be carrying over in the form of liquid globules, while the current density is very high. In working with a short arc there seems to be a globular accumulation of molten metal at the electrode end until contact is made with the anode surface wet with its own liquefaction, when the globule passes on to the plate, to be followed by others.

In bessemer steel the occluded gas is considerable and its expansion produces cavities in the liquefied electrode and on the whole tends to interfere with the process of making a smooth and homogeneous weld. Mr. Eschholz's studies of the details of the transference of metal in welding show the general character of the action very clearly and throw considerable light on the conditions necessary to making a uniform and reliable weld.

Results Achieved in Burning Oil

NEW interest in oil-fired boilers brought about by the high price of coal makes particularly pertinent a brief article in this issue on operating results. Despite the large amount of fuel oil now used, most of the published results have dealt rather with general conditions and economies than with definite tests, so that the exact data here given are altogether welcome as furnishing a very needful basis for further work on oil-burning practice. The general advantages of oil as a fuel are quite obvious. Not only is it readily utilized and particularly convenient for forcing boiler output, but owing to the ease with which the fire is managed it becomes possible to insure virtually complete combustion with very little excess of air and to keep flue gases within reasonable temperatures. Of course, from the economic standpoint the whole matter hinges on the relative price of coal and oil and the permanence of the ratio between them, which is the most considerable matter of doubt. In making the comparison, however, the advantage of the oil in cutting out ash-disposal expense must not be left out of account. As to what oil really will do in the way of thermodynamic efficiency of boiler and furnace information has not generally been so precise as is desirable.

The tests deal with fuel oils ranging from 18,000 to a little over 19,000 B.t.u. per pound (2,052 cal. to 2,166 cal. per kg.), and the boilers were operated in some cases fairly near the rated capacity and in others at considerable over load or under load. The pressures ran in general from 175 lb. to nearly 200 lb. (12.3 kg. to 13.8 kg. per sq.cm.) and superheat from a little over 80 deg. to more than 180 deg. It will be observed,

however, that neither pressure nor superheat was in any way outside of every-day practice. In every instance the oil showed excellent results. The evaporation from and at 212 deg. per pound was in the main over 15 lb., except in cases of severe overload, and the steam used for the oil burners was, save in a single instance, quite moderate, roughly from 1 to 2½ per cent. The net efficiency, including steam, thus used at normal loads averaged very nearly 80 per cent, which will be recognized as an extremely good result judged from the standards of coal burning. The lowest efficiency recorded was 74 per cent in the case of a boiler worked at nearly double its rated capacity. The general indications of this series of tests confirm strongly the current opinion that oil burning has very great possibilities, always provided that the cost of the material can be to a certain extent stabilized. Here is the real difficulty of the situation and one which should be very carefully considered before embarking on any considerable change of power plants to oil fuel. It is pretty well understood that not only is American oil tied up in very few hands but that fuel-oil supply outside the United States is quite generally under British control. It therefore appears only too plain that any large demand for fuel oil on the part of power plants has remarkable possibilities in the way of bulling the market.

Reactive Power Indicators

THERE are few subjects relating to alternating-current systems which are more indefinitely discussed and loosely understood than reactive power, although this is a very important subject to central-station engineers.

If a simple single-phase circuit is reactanceless or contains resistance only, as is practically the case with a short distribution circuit supplying lamps only, then a wattmeter connected to the circuit will show the average power expended by the circuit.

If, however, the circuit is led through magnetizing coils, such as motor windings, the magnetic field developed in these windings when the current flows requires energy to create it of the type LI^2 joules, where L is the inductance in henries and I is the instantaneous current in amperes. This energy of magnetism is a maximum when the alternating current is at a crest value and disappears when the current is at zero. It is necessary to develop power when such magnetic energy is rapidly supplied to and removed from the coils. This power is just as truly watts as the power developed in the lamps, except that the average of the magnetic power is zero; because it is not expended but is only power of circulating energy lent to the coils and then withdrawn once in each current alternation. The magnetizing watts are also in quadrature to the dissipated or heating watts.

If now the same single-phase circuit supplies 20 amp. of active current to lamps at 100 volts and also 5 amp. of reactive current to coils or motors, it will develop 2,000 active watts in heat, which will be expended and will leave the circuit. It will also develop 500 reactive watts in magnetic energy storage and release, which power is not expended and does not leave the circuit. Reactive power and energy are reclaimed. The main ammeter will show the vector sum of $20 - j5$ or 20.6 amp., lagging .14 deg. behind the impressed voltage. The active wattmeter will show 2,000 watts and the reactive wattmeter 500 watts. The total vector power is the vector sum of $2{,}000 - j500$, or 2,060 watts, lagging 14 deg. behind the active power.

Development of High-Tension Insulators

IN ITS report at the recent National Electric Light Association convention the overhead systems committee as usual presented much valuable information. In particular we note the report on insulator tests conducted at Leland Stanford Junior University for the last three or four years.

The tests referred to record the vicissitudes of thirteen varieties of suspension insulators, 50 to 100 of each type going into the test. The immediate result was to show startling differences as between the several groups, even when of about the same period and of a similar character in design. Two types of 1912, for instance, showed a total percentage of failures, on tests of between two and three years, of 5.6 and 60.3 respectively, while one 1916 insulator showed no failures out of fifty-six specimens and another of the same date showed twenty-five complete failures out of seventy-six specimens. Careful analysis of the very thorough tests made seem to bring out three chief factors in deterioration. First, the porcelain must be of high grade and thoroughly fired, but not overfired. Second, the securing of one insulator to its neighbor in the string is a problem requiring a great deal of study. The porcelain-to-metal joint is the conspicuous weak point in the suspension insulator, and the mechanical working of such joints has been a fruitful source of failure. Various plans of somewhat elastic cementing have been worked out with fair success, but right here is an inherent difficulty that required the most careful investigation. Next, it was clearly brought out by the experiments that the daily and seasonal changes of temperature are chargeable with a considerable proportion of insulator failures. This thermal fatigue is probably the main factor in deterioration. Not only do changes of temperature affect the joints but they also produce a startling change in the actual electrical resistance of the porcelain. A variation from 20 deg. to 40 deg. C. means at least a ten to one reduction in the insulation resistance. The exact cause for so great a temperature coefficient at such low temperatures is not easy to fathom, but the fact cannot be forgotten in relation to the final results. On a string of insulators the upper units tend to shield the lower ones from extreme temperature changes, and where the whole string is inside the station and temperature changes are relatively small the insulators show considerably better endurance.

Finally, the tests bring out strongly the desirability of electrostatic grading along the insulator strings. Without this the voltage duty of the disks next the line is unnecessarily severe. A grading system applied to the connected disks is found to equalize the strains along the string in a very striking manner so that the variation between maximum and minimum voltage duty can be changed from seven to one or more down to two to one. Even a single shield may reduce the voltage duty on the first disk by more than 20 per cent. The moral of this is obvious, that in working to the higher voltages grading is fundamentally necessary; without it the factor of safety of the string becomes greatly reduced.

Hugh L. Cooper

Designer of developments rated at a million and a half hydro-electric horsepower—Harnesser of the Mississippi and most active engineer in behalf of sound water-power legislation

UNFAILING to the call, day or night, for the last seven years, no matter where he was, Hugh L. Cooper has rushed to the assistance of those who have been trying to give the country sound and fair water-power legislation. The experience of the designer of developments totaling 1,500,000 hp. was, without thought of compensation, at the beck and call of that small band of enthusiasts whose vision convinced them that national conservation would be best served by the full utilization of the now wasting waters. Faced at the age of eighteen, when he was graduated from high school, with the career of a miller in his father's grist mill at Rushford, Minn., young Cooper decided to shift for himself otherwise. Carrying planks for the construction of a small wooden bridge marked his entrance into the profession of engineering. Rapidly advancing in the field of bridge building, he gradually became impressed with the possibilities that lay in water-power utilization. The development of 11,000 hp. on the Missouri River for the Montana Power Company was his first piece of hydro-electric engineering. Other developments quickly followed, notably the Niagara Falls plant of the Toronto Power Company, the Pennsylvania Water Power Company's station at McCall's Ferry on the Susquehanna, the Feather River plant of the Great Western Power Company, and later Lock 12 on the Coosa River for the Alabama Power Company. But his work was by no means confined to this country and Canada. Important plants of his design are now in operation in Mexico, Brazil and Japan, and work will probably be started next year in Egypt, on his design for damming the Nile. Above all of his accomplishments, however, there stands out one that will ever be a monument to the man's forcefulness and skill—harnessing the Mississippi at Keokuk. Staking all his resources and reputation on this project and faced time and again with almost certain disaster, his courage stood the test. He had the will to win.

Now that he has twice tasted the fruits of hard-earned victory, first on the Mississippi and later at Washington, the untamed engineer in Hugh L. Cooper calls for greater deeds. He is at this time actively working on two projects which will total 1,500,000 hp. He is also engaged by the United States government as consulting engineer on the Muscle Shoals nitrogen fixation development. During the war Mr. Cooper was commissioned colonel of engineers and placed in charge of all dock and wharf construction for the A. E. F. in France. Colonel Cooper was born April 28, 1865, at Rushford, Minn. He is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Engineers' Club and the Railroad Club.

Synopsis of New Water-Power Law*

Purport and Main Provisions Succinctly Stated—Projected Developments Totaling More Than 4,000,000 Hp. Have Been Held Up Awaiting Passage of the Bill — Complete Text of the Measure

By HENRY J. PIERCE†
President Columbia Valley Reclamation Company, Seattle, Wash.

THE new water-power law, which received the signature of President Wilson on June 11, is the result of eight years of work by committees of Congress and is one of the greatest pieces of constructive legislation ever enacted by the federal government. Some think its terms are too restrictive to be inviting to capital, but practical water-power men consider it to be reasonably fair.

A federal power commission is created by this new law, to be composed of the Secretaries of War, the Interior and Agriculture. To this commission authority is delegated over all matters pertaining to the development of water powers in which the federal government has jurisdiction or in which it is interested as the owner of land or other property necessary to such undertakings. The commission may issue preliminary permits, allowing applicants three years in which to make examinations of water-power projects, to prepare plans and to make financial arrangements. The commission may also issue licenses for a period of fifty years from the expiration of preliminary permits. The commission may reserve projects the development of which in its opinion should be undertaken by the United States government and report to Congress its opinions and suggestions regarding them, and it must give preference to states and municipalities in cases where it deems different projects equally well adapted to utilize the water resources of the region concerned.

HENRY J. PIERCE

Encouragement is given to the building of headwater storage reservoirs with a view to equalizing power production, preventing floods, and in arid states promoting the use of water for irrigation purposes on the lowlands after the water has been utilized for the generation of power. Provision is made for the construction of locks in power dams in navigable streams with a view to extending navigation into the upper reaches of such waters.

At the expiration of the fifty-year license the government will have the option of purchasing the hydro-electric plants by paying the licensee his net investment in them, or it may issue a new license to the original licensee, upon reasonable terms, or to a new licensee, who shall in that event pay the original owner his net investment in the plant. Under the terms of the law the United States may take over and operate any water-power plant under license during time of war for manufacture of explosives or for any purpose involving the safety of the country. The commission is authorized to make reasonable charges to cover the administration of the act and for the use of government lands and property and to take up excess profits which cannot be reached through regulation. Licensees are placed under supervision of state public service commissions as to rates to be charged consumers for power, and also as to regulation of service. Severe penalties are provided for noncompliance with the terms of the act.

Through failure of Congress to pass water-power laws under which money could be safely invested with a prospect of a fair return, water powers now going to waste in navigable streams have been held back from development for years in at least twenty-two states of the Union. The best information obtainable is to the effect that developments are projected having a total capacity of more than 2,000,000 hp. The completion of these projects would open up to navigation more than 4,000 miles of the upper reaches of our streams and rivers. The cost of these river improvements, if undertaken by the government, would be upward of $800,000,000, but if accomplished by private capital for the purpose of power production, instead of through taxation, they would not cost the government a dollar except for the locks and removal of minor obstacles in those portions of the streams not connected with power development. Passage of the measure means the extension of navigation for an aggregate of 4,000 miles in thirty-five rivers, traversing twenty states, in such widely different sections of the country as Connecticut, Massachusetts, Pennsylvania, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Alabama, Georgia, Tennessee, Florida, Arkansas, Ohio, Kentucky, Missouri, Wisconsin,

*A history of water-power legislation will be found in the ELECTRICAL WORLD for June 5, page 1328.

†Mr. Pierce has been associated more intimately probably with water-power legislation in the past seven years than any one else outside of official Washington. Mr. Pierce as president of the Columbia Valley Reclamation Company has desired to develop the now wasting water power of the Priest Rapids in the Columbia River, in the center of the State of Washington. This water power is situated in a desert country which has but 4 in. of rainfall per annum, but the soil, given water, will raise every crop that can be produced in the temperate zone. The Columbia Valley Reclamation Company owns the 12,000 acres of land which will be overflowed by the dam to be installed and has acquired all the necessary rights from the state. It also owns about 100,000 acres of agricultural land which it expects to bring under cultivation by water from that development. The capacity of this plant will be 300,000 all-the-year-round primary horsepower, and during the six months of the irrigation season the river rises sufficiently to develop another 300,000 hp. This auxiliary power can be used for agricultural purposes without disturbing in any way the primary power, which will be available for industrial uses, electrification of railroads and various other purposes.—EDITOR.

Minnesota, Washington and Idaho. In this way cheap water transportation would be afforded to districts now sparsely settled and congestion of traffic relieved in thickly populated centers through the investment of private capital instead of through river and harbor appropriations by Congress. It is believed that in addition to the above water-power projects others having an aggregate capacity of more than 2,000,000 hp. would be undertaken on non-navigable streams in the public domain in the States of Oregon, California, Montana, Nevada, Arizona, Wyoming, Colorado and Utah.

WATER-POWER DEVELOPMENT NOT A SECTIONAL CONCERN

To encourage water-power development is a national duty. It cannot be considered a local or a sectional question. It concerns every citizen of the United States, whether he dwells in the vicinity of a water power, in the city or upon the plains. The things used and consumed in every household are affected by the price at which those things can be produced under the cheapest of conditions. The cost of food, of clothing, of fertilizers, of explosives, and the convenience and facility of transportation, would all be beneficially affected by the development of water power to the utmost extent of its usefulness. Coal shortage shows the folly of having left unused the nation's vast resources of water power. The more these are developed the less desperate will be the fuel stringency. The waste is not alone one of money. It extends in its final direct result to public health and life itself, because these are affected by inability to get coal for heating and for the production of the necessities of life. Some experts estimate that at the present rate of coal consumption, and taking into consideration the increase that will come with access of population, all of our anthracite deposits and all of our high-grade deposits of bituminous coal will be exhausted within one hundred years. This statement has been denied more than once, but it is as strenuously affirmed.

The labor of one man is released for other uses every time 50 hydro-electric horsepower is developed, and every 150 hydro-electric horsepower developed releases one freight car from haulage for other duties.

WATER-POWER DEVELOPMENT IN EUROPE

Other countries are awake to the necessity of developing their water powers. A French corporation with $250,000,000 of capital is seeking funds in America to make possible the utilization of 700,000 hp. now wasting in the River Rhône, and incidentally these improvements will, through canalization, make it possible for steamers to go up the Rhône to its connection with the River Rhine and thence down the Rhine to the North Sea. Italy, which is virtually without coal, is about to develop her water powers on an immense scale. Spain is offering liberal concessions looking to the development of the water powers now wasting in the Pyrenees and other mountain ranges. Sweden is paying $46 per ton for coal, which she has to obtain from England, and is proceeding with the work of developing as much as possible of the entire 5,000,000 water horsepower contained within its boundaries. The enactment of the new water-power law places the United States in a position where it will not need to fall behind European countries in conserving its coal deposits and in developing the vast amount of cheap electrical energy contained in its wasting water power.

All the available water power in the United States should be developed in the quickest time possible, in the interest of the economic development of the country, of its social regeneration and of its wealth, and in order to permit it to obtain its share of the export markets of the world. Hydro-electric energy provides the means of saving coal, enabling electricity to be produced at a lower price and thus lowering in many cases industrial costs of production and improving agriculture. It will become the surest weapon in the economic struggle which faces us.

The new federal water-power law removes the sole cause which has prevented for fifteen years past the development of our wasting water powers. The removal, however, of federal government restrictions comes at a time when increased cost of labor and materials makes the expense of water-power development from two to three times what it would have been before the European war began, and scarcity of labor and material even at present prices will delay the work; but readjustment on a safer economic basis will undoubtedly come before long and enable this work of conservation to proceed.

The complete text of the bill follows, the section headings not being part of the act, but supplied by the ELECTRICAL WORLD:

AN ACT

To create a Federal Power Commission and to define its powers and duties, to provide for the improvement of navigation, for the development of water power, for the use of lands of the United States in relation thereto, to repeal Section 18 of "An act making appropriations for the construction, repair and preservation of certain public works on rivers and harbors, and for other purposes," approved Aug. 8, 1917, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That a commission is hereby created and established, to be known as the Federal Power Commission (hereinafter referred to as the commission), which shall be composed of the Secretary of War, the Secretary of the Interior and the Secretary of Agriculture. Two members of the commission shall constitute a quorum for the transaction of business, and the commission shall have an official seal, which shall be judicially noticed. The President shall designate the chairman of the commission.

The Executive Secretary

SEC. 2. That the commission shall appoint an executive secretary, who shall receive a salary of $5,000 a year, and prescribe his duties, and the commission may request the President of the United States to detail an officer from the United States Engineer Corps to serve the commission as engineer officer, his duties to be prescribed by the commission. The work of the commission shall be performed by and through the Departments of War, Interior and Agriculture and their engineering, technical, clerical and other personnel, except as may be otherwise provided by law.

All of the expenses of the commission, including rent in the District of Columbia, all necessary expenses for transportation and subsistence, including, in the discretion of the commission, a per diem of not exceeding $4 in lieu of subsistence incurred by its employees under its orders in making any investigation, or conducting field work, or upon official business outside of the District of Columbia and away from their designated points of duty, shall be allowed and paid on the presentation of itemized vouchers therefor approved by a member or officer of the commission duly authorized for that purpose; and in order to defray the expenses made necessary by the provisions of this act there is hereby authorized to be appropriated such sums as Congress may hereafter determine, and the sum of $100,000 is hereby appropriated, out of any moneys in the Treasury not otherwise appropriated, available until expended, to be paid out upon warrants drawn on the Secretary of the Treasury upon order of the commission.

Definition of Terms

SEC. 3. That the words defined in this section shall have the following meanings for the purposes of this act, to wit:

"Public lands" means such lands and interest in lands owned by the United States as are subject to private appropriation and disposal under public-land laws. It shall not include "reservations," as hereinafter defined.

"Reservations" means national monuments, national parks, national forests, tribal lands embraced within Indian reservations, military reservations and other lands and interests in lands owned by the United States, and withdrawn, reserved or withheld from private appropriation and disposal under the public-land laws; also lands and interests in lands acquired and held for any public purpose.

"Corporation" means a corporation organized under the laws of any state or of the United States empowered to develop, transmit, distribute, sell, lease or utilize power in addition to such other powers as it may possess and authorized to transact in the state or states in which its project is located all business necessary to effect the purpose of a license under this act. It shall not include "municipalities" as hereinafter defined.

"State" means a state admitted to the Union, the District of Columbia and any organized Territory of the United States.

"Municipality" means a city, county, irrigation district, drainage district or other political subdivision or agency of a state competent under the laws thereof to carry on the business of developing, transmitting, utilizing or distributing power.

"Navigable waters" means those parts of streams or other bodies of water over which

Congress has jurisdiction under its authority to regulate commerce with foreign nations and among the several states, and which either in their natural or improved condition, notwithstanding interruptions between the navigable parts of such streams or waters by falls, shallows or rapids compelling land carriage, are used or suitable for use for the transportation of persons or property in interstate or foreign commerce, including therein all such interrupting falls, shallows or rapids; together with such other parts of streams as shall have been authorized by Congress for improvement by the United States or shall have been recommended to Congress for such improvement after investigation under its authority.

"Municipal purposes" means and includes all purposes within municipal powers as defined by the constitution or laws of the state or by the charter of the municipality.

"Government dam" means a dam or other work, constructed or owned by the United States for government purposes, with or without contribution from others.

"Project" means complete unit of improvement or development, consisting of a power house, all water conduits, all dams and appurtenant works and structures (including navigation structures) which are a part of said unit, and all storage, diverting or forebay reservoirs directly connected therewith, the primary line or lines transmitting power therefrom to the point of junction with the distribution system or with the interconnected primary transmission system, all miscellaneous structures used and useful in connection with said unit or any part thereof, and all water rights, rights-of-way, ditches, dams, reservoirs, lands or interest in lands the use and occupancy of which are necessary or appropriate in the maintenance and operation of such unit.

"Project works" means the physical structures of a project.

"Net investment" in a project means the actual legitimate original cost thereof as defined and interpreted in the "classification of investment in road and equipment of steam roads, issue of 1914, Interstate Commerce Commission," plus similar costs of additions thereto and betterments thereof, minus the sum of the following items properly allocated thereto, if and to the extent that such items have been accumulated during the period of the license from earnings in excess of a fair return on such investment: (a) Unappropriated surplus, (b) aggregate credit balances of current depreciation accounts, and (c) aggregate appropriations of surplus or income held in amortization, sinking fund or similar reserves, or expended for additions or betterments or used for the purposes for which such reserves were created. The term "cost" shall include, in so far as applicable, the elements thereof prescribed in said classification, but shall not include expenditures from funds obtained through donations by states, municipalities, individuals or others, and said classification of investment of the Interstate Commerce Commission shall in so far as applicable be published and promulgated as a part of the rules and regulations of the commission.

Powers of the Commission

SEC. 4. That the commission is hereby authorized and empowered—

(a) To make investigations and to collect and record data concerning the utilization of the water resources of any region to be developed, the water-power industry and its relation to other industries and to interstate or foreign commerce, and concerning the location, capacity, development costs and relation to markets of power sites, and whether the power from government dams can be advantageously used by the United States for its public purposes, and what is a fair value of such power, to the extent the commission may deem necessary or useful for the purposes of this act. In order to aid the commission in determining the net investment of a licensee in any project, the licensee shall, upon oath, within a reasonable period of time, to be fixed by the commission, after the construction of the original project or any addition thereto or betterment thereof, file with the commission, in such detail as the commission may require, a statement in duplicate showing the actual legitimate cost of construction of such project, addition or betterment, and the price paid for water rights, rights-of-way, lands or interest in lands. The commission shall deposit one of said statements with the Secretary of the Treasury. The licensee shall grant to the commission or to its duly authorized agent or agents, at all reasonable times, free access to such project, addition or betterment, and to all maps, profiles, contracts, reports of engineers, accounts, books, records and all other papers and documents relating thereto.

(b) To co-operate with the executive departments and other agencies of state or national governments in such investigations; and for such purpose the several departments and agencies of the national government are authorized and directed upon the request of the commission, to furnish such records, papers and information in their possession as may be requested by the commission, and temporarily to detail to the commission such officers or experts as may be necessary in such investigations.

(c) To make public from time to time the information secured hereunder, and to provide for the publication of its reports and investigations in such form and manner as may be best adapted for public information and use. The commission, on or before the first Monday in December of each year, shall submit to Congress for the fiscal year preceding a classified report showing the permits and licenses issued under this act, and in each case the parties thereto, the terms prescribed and the moneys received, if any, on account thereof.

(d) To issue licenses to citizens of the United States or to any association of such citizens, or to any corporation organized under the laws of the United States or any state thereof, or to any state or municipality, for the purpose of constructing, operating and maintaining dams, water conduits, reservoirs, power houses, transmission lines or other project works necessary or convenient for the development and improvement of navigation, and for the development, transmission and utilization of power across, along, from or in any of the navigable waters of the United States, or upon any part of the public lands and reservations of the United States (including the Territories), or for the purpose of utilizing the surplus water or water power from any government dam, except as herein provided: Provided, that licenses shall be issued within any reservation only after a finding by the commission that the license will not interfere or be inconsistent with the purpose for which such reservation was created or acquired, and shall be subject to and contain such conditions as the Secretary of the department under whose supervision such reservation falls shall deem necesary for the adequate protection and utilization of such reservation: Provided, further, that no license affecting the navigable capacity of any navigable waters of the United States shall be issued until the plans of the dam or other structures affecting navigation have been approved by the Chief of Engineers and the Secretary of War. Whenever the contemplated improvement is, in the judgment of the commission, desirable and justified in the public interest for the purpose of improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, a finding to that effect shall be made by the commission and shall become a part of the records of the commission: Provided further, that in case the commission shall find that any government dam may be advantageously used by the United States for public purposes in addition to navigation, no license therefor shall be issued until two years after it shall have reported to Congress the facts and conditions relating thereto, except that this provision shall not apply to any government dam constructed prior to the passage of this act: And provided further that upon the filing of any application for a license which has not been preceded by a preliminary permit under subsection (e) of this section, notice shall be given and published as required by the proviso of said subsection.

(e) To issue preliminary permits for the purpose of enabling applicants for a license hereunder to secure the data and to perform the acts required by Section 9 hereof: Provided, however, that upon the filing of any application for a preliminary permit by any person, association or corporation the commission, before granting such application, shall at once give notice of such application in writing to any state or municipality likely to be interested in or affected by such application, and shall also publish notice of such application for eight weeks in a daily or weekly newspaper published in the county or counties in which the project or any part thereof or the lands affected thereby are situated.

(f) To prescribe rules and regulations for the establishment of a system of accounts and for the maintenance thereof by licensees hereunder; to examine all books and accounts of such licensees at any time; to require them to submit at such time or times as the commission may require statements and reports, including full information as to assets and liabilities, capitalization, net investment and reduction thereof, gross receipts, interest due and paid, depreciation and other reserves, cost of project, cost of maintenance and operation of the project, cost of renewals and replacements of the project works, and as to depreciation of the project works and as to production, transmission, use and sale of power; also to require any licensee to make adequate provision for currently determining said costs and other facts. All such statements and reports shall be made upon oath, unless otherwise specified, and in such form and on such blanks as the commission may require. Any person who, for the purpose of deceiving, makes or causes to be made any false entry in the books or the accounts of such licensee, and any person who, for the purpose of deceiving, makes or causes to be made any false statement or report in response to a request or order or direction from the commission for the statements and reports herein referred to, shall, upon conviction, be fined not more than $2,000 or imprisoned not more than five years, or both.

(g) To hold hearings and to order testimony to be taken by deposition at any designated place in connection with the application for any permit or license, or the regulation of rates, service or securities, or the making of any investigation, as provided in this act; and to require by subpoena, signed by any member of the commission, the attendance and testimony of witnesses and the production of documentary evidence from any place in the United States, and in case of disobedience to a subpoena the commission may invoke the aid of any court of the United States in requiring the attendance and testimony of witnesses and the production of documentary evidence. Any member, expert or examiner of the commission may, when duly designated by the commission for such purposes, administer oaths and affirmations, examine witnesses and receive evidence. Depositions may be taken before any person designated by the commission or by its executive secretary, and empowered to administer oaths, shall be reduced to writing by such person or under his direction and subscribed by the deponent. Witnesses summoned before the commission shall be paid the same fees and mileage that are paid witnesses in the courts of the United States, and witnesses whose depositions are taken and persons taking the same shall severally be entitled to the same fees as are paid for like services in the courts of the United States.

(h) To perform any and all acts, to make such rules and regulations and to issue such orders not inconsistent with this act as may be necessary and proper for the purpose of carrying out the provisions of this act.

Preliminary Permits

SEC. 5. That each preliminary permit issued under this act shall be for the sole purpose of maintaining priority of application for a license under the terms of this act for such period or periods, not exceeding a total of three years, as in the discretion of the commission may be necessary for making examinations and surveys, for preparing maps, plans, specifications and estimates, and for making financial arrangements. Each such permit shall set forth the conditions under which priority shall be maintained and a license issued. Such permits shall not be transferable and may be canceled by order of the commission upon failure of permittees to comply with the conditions thereof.

Fifty-Year Licenses

SEC. 6. That licenses under this act shall be issued for a period of not exceeding fifty years. Each such license shall be conditioned upon acceptance by the licensee of all the terms and conditions of this act and such further conditions, if any, as the commission shall prescribe in conformity with this act, which said terms and conditions and the acceptance thereof shall be expressed in said license. Licenses may be revoked only for the reasons and in the manner prescribed under the provisions of this act, and may be altered or surrendered only upon mutual agreement between the licensee and the commission after ninety days' public notice.

Preference to States and Municipalities

SEC. 7. That in issuing preliminary permits hereunder or licenses where no preliminary permit has been issued and in issuing licenses to new licensees under Section 15 hereof the commission shall give preference to applications therefor by states and municipalities, provided the plans for the same are deemed by the commission equally well adapted, or shall within a reasonable time to be fixed by the commission be made equally well adapted, to conserve and util-

ize in the public interest the navigation and water resources of the region; and as between other applicants, the commission may give preference to the applicant the plans of which it finds and determines are best adapted to develop, conserve and utilize in the public interest the navigation and water resources of the region, if it be satisfied as to the ability of the applicant to carry out such plans.

That whenever, in the judgment of the commission, the development of any project should be undertaken by the United States itself, the commission shall not approve any application for such project by any citizen, association, corporation, state or municipality, but shall cause to be made such examinations, surveys, reports, plans and estimates of the cost of the project as it may deem necessary, and shall submit its findings to Congress with such recommendations as it may deem appropriate concerning the construction of such project or completion of any project upon any government dam by the United States.

The commission is hereby authorized and directed to investigate and, on or before the first day of January, 1921, report to Congress the cost and, in detail, the economic value of the power plant outlined in project numbered three, House Document numbered 1400, Sixty-second Congress, third session, in view of existing conditions, utilizing such study as may heretofore have been made by any department of the government; also in connection with such project to submit plans and estimates of cost necessary to secure an increased and adequate water supply for the District of Columbia. For this purpose the sum of $25,000, or so much thereof as may be necessary, is hereby appropriated.

Transfer of Licenses

SEC. 8. That no voluntary transfer of any license, or of the rights thereunder granted, shall be made without the written approval of the commission; and any successor or assign of the rights of such licensee, whether by voluntary transfer, judicial sale, foreclosure sale or otherwise, shall be subject to all the conditions of the license under which such rights are held by such licensee and also subject to all the provisions and conditions of this act to the same extent as though such successor or assign were the original licensee hereunder: Provided, that a mortgage of trust deed or judicial sales made thereunder or under tax sales shall not be deemed voluntary transfers within the meaning of this section.

Information Required of Applicants

SEC. 9. That each applicant for a license hereunder shall submit to the commission—

(a) Such maps, plans, specifications and estimates of cost as may be required for a full understanding of the proposed project. Such maps, plans and specifications when approved by the commission shall be made a part of the license; and thereafter no change shall be made in said maps, plans or specifications until such changes shall have been approved and made a part of such license by the commission.

(b) Satisfactory evidence that the applicant has complied with the requirements of the laws of the state or states within which the proposed project is to be located with respect to bed and banks and to the appropriation, diversion and use of water for power purposes and with respect to the right to engage in the business of developing, transmitting, and distributing power, and in any other business necessary to effect the purposes of a license under this act.

(c) Such additional information as the commission may require.

Conditions of Licenses

SEC. 10. That all licenses issued under this act shall be on the following conditions:

(a) That the project adopted, including the maps, plans and specifications, shall be such as in the judgment of the commission will be best adapted to a comprehensive scheme of improvement and utilization for the purposes of navigation, of water-power development and of other beneficial public uses; and if necessary in order to secure such scheme the commission shall have authority to require the modification of any project and of the plans and specifications of the project works before approval.

(b) That except when emergency shall require for the protection of navigation, life, health or property, no substantial alteration or addition not in conformity with the approved plans shall be made to any dam or other project works constructed hereunder of a capacity in excess of one hundred horsepower without prior approval of the commission; and any emergency alteration or addition so made shall thereafter be subject to such modification and changes as the commission may direct.

(c) That the licensee shall maintain the project works in a condition of repair adequate for the purposes of navigation and for the efficient operation of said works in the development and transmission of power, shall make all necessary renewals and replacements, shall establish and maintain adequate depreciation reserves for such purposes, shall so maintain and operate said works as not to impair navigation, and shall conform to such rules and regulations as the commission may from time to time prescribe for the protection of life, health and property. Each licensee hereunder shall be liable for all damages occasioned to the property of others by the construction, maintenance or operation of the project works, or of the works appurtenant or accessory thereto, constructed under the license, and in no event shall the United States be liable therefor.

(d) That after the first twenty years of operation out of surplus earned thereafter, if any, accumulated in excess of a specified reasonable rate of return upon the actual, legitimate investment of a licensee in any project or projects under license the licensee shall establish and maintain amortization reserves, which reserves shall, in the discretion of the commission, be held until the termination of the license or be applied from time to time in reduction of the net investment. Such specified rate of return and the proportion of such surplus earnings to be paid into and held in such reserves shall be set forth in the license.

(e) That the licensee shall pay to the United States reasonable annual charges in an amount to be fixed by the commission for the purpose of reimbursing the United States for the costs of the administration of this act; for recompensing it for the use, occupancy and enjoyment of its lands or other property, and for the expropriation to the government of excessive profits until the respective states shall make provision for preventing excessive profits or for the expropriation thereof to themselves, or until the period of amortization as herein provided is reached, and in fixing such charges the commission shall seek to avoid increasing the price to the consumers of power by such charges, and charges for the expropriation of excessive profits may be adjusted from time to time by the commission as conditions may require: Provided, that when licenses are issued involving the use of government dams or other structures owned by the United States or tribal lands embraced within Indian reservations the commission shall fix a reasonable annual charge for the use thereof, and such charges may be readjusted at the end of twenty years after the beginning of operations and at periods of not less than ten years thereafter in a manner to be described in each license: Provided, that licenses for the development, transmission or distribution of power by states or municipalities shall be issued and enjoyed without charge to the extent such power is sold to the public without profit or is used by such state or municipality for state or municipal purposes except that as to projects constructed or to be constructed by states or municipalities primarily designed to provide or improve navigation licenses therefor shall be issued without charge; and that licenses for the development, transmission or distribution of power for domestic, mining or other beneficial use in projects of not more than one hundred horsepower capacity may be issued without charge except on tribal lands within Indian reservations; but in no case shall a license be issued free of charge for the development and utilization of power created by any government dam, and that the amount charged therefor in any license shall be such as determined by the commission.

(f) That whenever any licensee hereunder is directly benefited by the construction work of another licensee, a permittee, or of the United States of a storage reservoir or other headwater improvement, the commission shall require as a condition of the license that the licensee so benefited shall reimburse the owner of such reservoir or other improvement for such part of the annual charges for interest, maintenance and depreciation thereon as the commission may deem equitable. The proportion of such charges to be paid by any licensee shall be determined by the commission. Whenever such reservoir or other improvement is constructed by the United States the commission shall assess similar charges against any licensee directly benefited thereby, and any amount so assessed shall be paid into the Treasury of the United States, to be reserved and appropriated as a part of the special fund for headwater improvement as provided in Section 17 hereof.

(g) Such further conditions not inconsistent with the provisions of this act as the commission may require.

(h) That combinations, agreements, arrangements or understandings, express or implied, to limit the output of electrical energy, to restrain trade, or to fix, maintain or increase prices for electrical energy or service are hereby prohibited.

(i) In issuing licenses for a minor part only of a complete project, or for a complete project of not more than one hundred horsepower capacity, the commission may in its discretion waive such conditions, provisions and requirements of this act, except the license period of fifty years, as it may deem to be to the public interest to waive under the circumstances: Provided, that the provisions hereof shall not apply to lands within Indian reservations.

Promotion of Needs of Navigation

SEC. 11. That if the dam or other project works are to be constructed across, along or in any of the navigable waters of the United States, the commission may, in so far as it deems the same reasonably necessary to promote the present and future needs of navigation and consistent with a reasonable investment cost to the licensee, include in the license any one or more of the following provisions or requirements:

(a) That such licensee shall, to the extent necessary to preserve and improve navigation facilities, construct, in whole or in part, without expense to the United States, in connection with such dam, a lock or locks, booms, sluices or other structures for navigation purposes, in accordance with plans and specifications approved by the Chief of Engineers and the Secretary of War and made part of such license.

(b) That in case such structures for navigation purposes are not made a part of the original construction at the expense of the licensee, then whenever the United States shall desire to complete such navigation facilities the licensee shall convey to the United States, free of cost, such of its land and its rights-of-way and such right of passage through its dams or other structures, and permit such control of pools as may be required to complete such navigation facilities.

(c) That such licensee shall furnish free of cost to the United States power for the operation of such navigation facilities, whether constructed by the licensee or by the United States.

Construction of Locks

SEC. 12. That whenever application is filed for a project hereunder involving navigable waters of the United States, and the commission shall find upon investigation that the needs of navigation require the construction of a lock or locks or other navigation structures, and that such structures cannot, consistent with a reasonable investment cost to the applicant, be provided in the manner specified in Section 11, Subsection (a) hereof, the commission may grant the application with the provision to be expressed in the license that the licensee will install the necessary navigation structures if the government fails to make provision therefor within a time to be fixed in the license and cause a report upon such project to be prepared, with estimates of cost of the power of development and of the navigation structures, and shall submit such report to Congress with such recommendations as it deems appropriate concerning the participation of the United States in the cost of construction of such navigation structures.

Two-Year Limit for Beginning Works

SEC. 13. That the licensee shall commence the construction of the project works within the time fixed in the license, which shall not be more than two years from the date thereof, shall thereafter in good faith and with due diligence prosecute such construction, and shall within the time fixed in the license complete and put into operation such part of the ultimate development as the commission shall deem necessary to supply the reasonable needs of the then available market, and shall from time to time thereafter construct such portion of the balance of such development as the commission may direct, so to supply adequately the reasonable market demands until such development shall have been completed. The periods for the commencement of construction may be extended once but not longer than two additional years, and the period for the completion of construction carried on in good faith and with reasonable diligence may be extended by the commission when not incompatible with the public interests. In case the licensee shall not commence actual construction of the project works, or of any specified part thereof, within the time prescribed in the

license or as extended by the commission, then, after due notice given, the license shall, as to such project works or part thereof, be terminated upon written order of the commission. In case the construction of the project works, or of any specified part thereof, have been begun but not completed within the time prescribed in the license, or as extended by the commission, then the Attorney General, upon the request of the commission, shall institute proceedings in equity in the district court of the United States for the district in which any part of the project is situated for the revocation of said license, the sale of the works constructed and such other equitable relief as the case may demand, as provided for in Section 26 hereof.

Privilege of Recapture by United States

SEC. 14. That upon not less than two years' notice in writing from the commission the United States shall have the right upon, on or after the expiration of any license, to take over and thereafter to maintain and operate any project or projects as defined in Section 3 hereof, and covered in whole or in part by the license, or the right to take over upon mutual agreement with the licensee all property owned and held by the licensee then valuable and serviceable in the development, transmission or distribution of power and which is then dependent for its usefulness upon the continuance of the license, together with any lock or locks or other aids to navigation constructed at the expense of the licensee, upon the condition that before taking possession it shall pay the net investment of the licensee in the project or projects taken, not to exceed the fair value of the property taken, plus such reasonable damages, if any, to property of the licensee valuable, serviceable and dependent as above set forth, but not taken, as may be caused by the severance therefrom of property taken, and shall assume all contracts entered into by the license with the approval of the commission. The net investment of the licensee in the project or projects so taken and the amount of such severance damages, if any, shall be determined by agreement between the commission and the licensee, and in case they can not agree, by proceedings in equity instituted by the United States in the district court of the United States in the district within which any such property may be located: Provided, that such net investment shall not include or be affected by the value of any lands, rights-of-way or other property of the United States licensed by the commission under this act, by the license, or by good will, going value or prospective revenues: Provided further, that the values allowed for water rights, rights-of-way, lands or interest in lands shall not be in excess of the actual reasonable cost thereof at the time of acquisition by the licensee: Provided, that the right of the United States or any state or municipality to take over, maintain and operate any project licensed under this act at any time by condemnation proceedings upon payment of just compensation is hereby expressly reserved.

Provision for New License

SEC. 15. That if the United States does not, at the expiration of the original license, exercise its right to take over, maintain and operate any project or projects of the licensee, as provided in Section 14 hereof, the commission is authorized to issue a new license to the original licensee upon such terms and conditions as may be authorized or required under the then existing laws and regulations, or to issue a new license under said terms and conditions to a new licensee, which license may cover any project or projects covered by the original license, and shall be issued on the condition that the new licensee shall, before taking possession of such project or projects, pay such amount and assume such contracts as the United States is required to do, in the manner specified in Section 14 hereof: Provided, that in the event the United States does not exercise the right to take over or does not issue a license to a new licensee, or issue a new license to the original licensee, upon reasonable terms, then the commission shall issue from year to year an anual license to the then licensee under the terms and conditions of the original license until the property is taken over or a new license is issued as aforesaid.

War Powers of Government

SEC. 16. That when in the opinion of the President of the United States, evidenced by a written order addressed to the holder of any license hereunder, the safety of the United States demands it, the United States shall have the right to enter upon and take possession of any project or part thereof, constructed, maintained or operated under said license, for the purpose of manufacturing nitrates, explosives or munitions of war, or for any other purpose involving the safety of the United States, to retain possession, management and control thereof for such length of time as may appear to the President to be necessary to accomplish said purposes, and then to restore possession and control to the party or parties entitled thereto; and in the event that the United States shall exercise such right it shall pay to the party or parties entitled thereto just and fair compensation for the use of said property as may be fixed by the commission upon the basis of a reasonable profit in time of peace, and the cost of restoring said property to as good condition as existed at the time of the taking over thereof, less the reasonable value of any improvements that may be made thereto by the United States and which are valuable and serviceable to the licensee.

Indian Reservation Proceeds

SEC. 17. That all proceeds from any Indian reservation shall be placed to the credit of the Indians of such reservation. All other charges arising from licenses hereunder shall be paid into the Treasury of the United States, subject to the following distribution: Twelve and one-half per centum thereof is hereby appropriated to be paid into the Treasury of the United States and credited to "miscellaneous receipts"; 50 per centum of the charges arising from licenses hereunder for the occupancy and use of public lands, national monuments, national forests and national parks shall be paid into, reserved and appropriated as a part of the reclamation fund created by the act of Congress known as the reclamation act, approved June 17, 1902; and 37½ per centum of the charges arising from licenses hereunder for the occupancy and use of national forests, national parks, public lands and national monuments, from development within the boundaries of any state, shall be paid by the Secretary of the Treasury to such state; and 50 per centum of the charges arising from all other licenses hereunder is hereby reserved and appropriated as a special fund in the Treasury to be expended under the direction of the Secretary of War in the maintenance and operation of dams and other navigation structures owned by the United States or in the construction, maintenance or operation of headwater or other improvements of navigable waters of the United States.

Operation of Navigation Facilities

SEC. 18. That the operation of any navigation facilities which may be constructed as a part of or in connection with any dam or diversion structure built under the provisions of this act, whether at the expense of a licensee hereunder or of the United States, shall at all times be controlled by such reasonable rules and regulations in the interest of navigation, including the control of the level of the pool caused by such dam or diversion structure, as may be made from time to time by the Secretary of War. Such rules and regulations may include the maintenance and operation by such licensee at its own expense of such lights and signals as may be directed by the Secretary of War and such fishways as may be prescribed by the Secretary of Commerce; and for willful failure to comply with any such rule or regulation such licensee shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished as provided in Section 25 hereof.

Regulation of Rates and Charges

SEC. 19. That as a condition of the license every licensee hereunder which is a public service corporation or a person, association or corporation owning or operating any project and developing, transmitting or distributing power for sale or use in public service shall abide by such reasonable regulation of the services to be rendered to customers or consumers of power, and of rates and charges of payment therefor, as may from time to time be prescribed by any duly constituted agency of the state in which the service is rendered or the rate charged. That in case of the development, transmission or distribution or use in public service of power by any licensee hereunder or by its customer engaged in public service within a state which has not authorized and empowered a commission or other agency or agencies within said state to regulate and control the services to be rendered by such licensee or by its customer engaged in public service, or the rates and charges of payment therefor, or the amount or character of securities to be issued by any of said parties, it is agreed as a condition of such license that jurisdiction is hereby conferred upon the commission, upon complaint of any person aggrieved or upon its own initiative, to exercise such regulation and control until such time as the state shall have provided a commission or other authority for such regulation and control: Provided that the jurisdiction of the commission shall cease and determine as to each specific matter of regulation and control prescribed in this section as soon as the state shall have provided a commission or other authority for the regulation and control of that specific matter.

Interstate and Foreign Commerce

SEC. 20. That when said power or any part thereof shall enter into interstate or foreign commerce the rates charged and the service rendered by any such licensee, or by any subsidiary corporation the stock of which is owned or controlled directly or indirectly by such licensee, or by any person, corporation or association purchasing power from such licensee for sale and distribution or use in public service, shall be reasonable, non-discriminatory and just to the customer and all unreasonable, discriminatory and unjust rates of services are hereby prohibited and declared to be unlawful; and whenever any of the states directly concerned has not provided a commission or other authority to enforce the requirements of this section within such state or to regulate and control the amount and character of securities to be issued by any of such parties, or such states are unable to agree through their properly constituted authorities on the services to be rendered or on the rates or charges of payment therefor, or on the amount or character of securities to be issued by any of said parties, jurisdiction is hereby conferred upon the commission, upon complaint of any person aggrieved, upon the request of any state concerned, or upon its own initiative, to enforce the provisions of this section, to regulate and control so much of the services rendered and of the rates and charges of payment therefor as constitute interstate or foreign commerce and to regulate the issuance of securities by the parties included within this section, and securities issued by the licensee subject to such regulations shall be allowed only for the bona fide purpose of financing and conducting the business of such licensee.

The administration of the provisions of this section, so far as applicable, shall be according to the procedure and practice in fixing and regulating the rates, charges and practices of railroad companies as provided in the act to regulate commerce, approved Feb. 4, 1887, as amended, and that the parties subject to such regulation shall have the same rights of hearing, defense and review as said companies in such cases.

In any valuation of the property of any licensee hereunder for purposes of rate-making no value shall be claimed by the licensee or allowed by the commission for any project or projects under license in excess of the value or values prescribed in Section 14 hereof for the purposes of purchase by the United States, but there shall be included the cost to such licensee of the construction of the lock or locks or other aids of navigation and all other capital expenditures required by the United States, and no value shall be claimed or allowed for the rights granted by the commission or by this act.

Right of Eminent Domain

SEC. 21. That when any licensee cannot acquire by contract or pledges an unimproved dam site or the right to use or damage the lands or property of others necessary to the construction, maintenance or operation of any dam, reservoir, diversion structure or the works appurtenant or accessory thereto, in conjunction with an improvement which in the judgment of the commission is desirable and justified in the public interest for the purpose of improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, it may acquire the same by the exercise of the right of eminent domain in the district court of the United States for the district in which such land or other property may be located, or in the state courts. The practice and procedure in any action or proceeding for that purpose in the district court of the United States shall conform as nearly as may be with the practice and procedure in similar action or proceeding in the courts of the state where the property is situated: Provided, that United States district courts shall only have jurisdiction of cases when the amount claimed by the owner of the property to be condemned exceeds $3,000.

Extension of Contracts

SEC. 22. That whenever the public interest requires or justifies the execution by the licensee of contracts for the sale and de-

livery of power for periods extending beyond the date of termination of the license, such contracts may be entered into upon the joint approval of the commission and of the public service commission or other similar authority in the state in which the sale or delivery of power is made, or if sold or delivered in a state which has no such public service commission, then upon the approval of the commission, and thereafter, in the event of failure to issue a new license to the original licensee at the termination of the license, the United States or the new licensee, as the case may be, shall assume and fulfill all such contracts.

Existing Permits and Rights-of-Way Not Affected

SEC. 23. That the provisions of this act shall not be construed as affecting any permit or valid existing rights-of-way heretofore granted, or as confirming or otherwise affecting any claim or as affecting any authority heretofore given pursuant to law, but any person, association, corporation, state or municipality holding or possessing such permit, right-of-way or authority may apply for a license hereunder, and upon such application the commission may issue to any such applicant a license in accordance with the provisions of this act, and in such case the provisions of this act shall apply to such applicant as a licensee hereunder: Provided, that when application is made for a license under this section for a project or projects already constructed, the fair value of said project or projects, determined as provided in this section, shall for the purposes of this act and of said license be deemed to be the amount to be allowed as the net investment of the applicant in such project or projects as of the date of such license, or as of the date of such determination, if license has not been issued. Such fair value may, in the discretion of the commission, be determined by mutual agreement between the commission and the applicant, or, in case they cannot agree, jurisdiction is hereby conferred upon the district court of the United States in the district within which such project or projects may be located, upon the application of either party, to hear and determine the amount of such fair value.

That any person, association, corporation, state or municipality intending to construct a dam or other project works across, along, over or in any stream or part thereof, other than those defined herein as navigable waters and over which Congress has jurisdiction under its authority to regulate commerce between foreign nations and among the several states, may in their discretion file declaration of such intention with the commission, whereupon the commission shall cause immediate investigation of such proposed construction to be made, and if upon investigation it shall find that the interests of interstate or foreign commerce would be affected by such proposed construction, such person, association, corporation, state or municipality shall not proceed with such construction until it shall have applied for and shall have received a license under the provisions of this act. If the commission shall not so find, and if no public lands or reservations are affected, permission is hereby granted to construct such dam or other project works in such stream upon compliance with state laws.

Reservation of Land Applied For Against Entry

SEC. 24. That any lands of the United States included in any proposed project under the provisions of this act shall from the date of filing of application therefor be reserved from entry, location or other disposal under the laws of the United States until otherwise directed by the commission or by Congress. Notice that such application has been made, together with the date of filing thereof and a description of the lands of the United States affected thereby, shall be filed in the local land office for the district in which such lands are located. Whenever the commission shall determine that the value of any lands of the United States so applied for, or heretofore or hereafter reserved or classified as power sites, will not be injured or destroyed for the purposes of power development by location, entry or selection under the public land laws, the Secretary of the Interior, upon notice of such determination, shall declare such lands open to location, entry or selection, subject to and with a reservation of the right of the United States or its permittees or licensees to enter upon, occupy and use any part or all of said lands necessary, in the judgment of the commission, for the purposes of this act, which right shall be expressly reserved in every patent issued for such lands; and no claim or right to compensation shall accrue from the occupation or use of any of said lands for said purposes. The United States or any licensee for any such lands hereunder may enter thereupon for the purposes of this act, upon payment of any damages to crops, buildings or other improvements caused thereby to the owner thereof, or upon giving a good and sufficient bond to the United States for the use and benefit of the owner to secure the payment of such damages as may be determined and fixed in an action brought upon the bond in a court of competent jurisdiction, said bond to be in the form prescribed by the commission: Provided, that locations, entries, selections or filings heretofore made for lands reserved as water-power sites or in connection with water-power development or electrical transmission may proceed to approval or patent under and subject to the limitations and conditions in this section contained.

Penalty for Non-Compliance

SEC. 25. That any licensee or any person who shall willfully fail or who shall refuse to comply with any of the provisions of this act, or with any of the conditions made a part of any license issued hereunder, or with any subpoena of the commission, or with any regulation or lawful order of the commission, or of the Secretary of War, or of the Secretary of Commerce as to fishways, issued or made in accordance with the provisions of this act, shall be deemed guilty of a misdemeanor, and on conviction thereof shall, in the discretion of the court, be punished by a fine of not exceeding $1,000, in addition to other penalties herein prescribed or provided by law; and every month any such licensee or any such person shall remain in default after written notice from the commission, or from the Secretary of War, or from the Secretary of Commerce, shall be deemed a new and separate offense punishable as aforesaid.

Revocation of Permits or Licenses

SEC. 26. That the Attorney General may, on request of the commission or of the Secretary of War, institute proceedings in equity in the district court of the United States in the district in which any project or part thereof is situated for the purpose of revoking for violation of its terms any permit or license issued hereunder, or for the purpose of remedying or correcting by injunction, mandamus or other process any act of commission or omission in violation of the provisions of this act or of any lawful regulation or order promulgated hereunder. The district courts shall have jurisdiction over all of the above-mentioned proceedings and shall have power to issue and execute all necessary process and to make and enforce all writs, orders and decrees to compel compliance with the lawful orders and regulations of the commission and of the Secretary of War, and to compel the performance of any condition imposed under the provisions of this act. In the event a decree revoking a license is entered, the court is empowered to sell the whole or any part of the project or projects under license, to wind up the business of such licensee conducted in connection with such project or projects, to distribute the proceeds to the parties entitled to the same, and to make and enforce such further orders and decrees as equity and justice may require. At such sale or sales the vendee shall take the rights and privileges belonging to the licensee and shall perform the duties of such licensee and assume all outstanding obligations and liabilities of the licensee which the court may deem equitable in the premises; and at such sale or sales the United States may become a purchaser, but it shall not be required to pay a greater amount than it would be required to pay under the provisions of Section 14 hereof at the termination of the license.

State Laws Not Interfered With

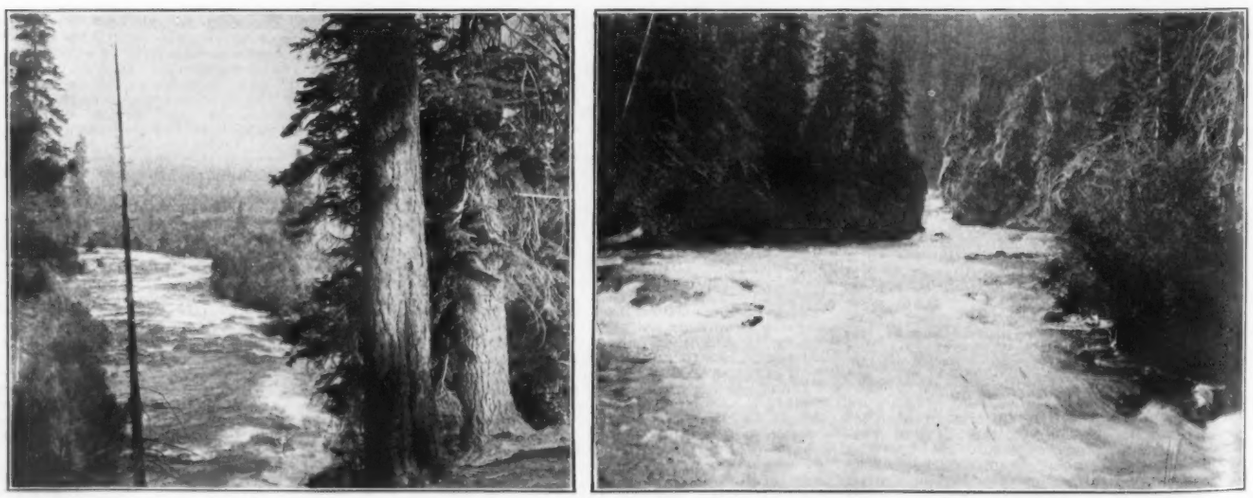
SEC. 27. That nothing herein contained shall be construed as affecting or intending to affect or in any way to interfere with the laws of the respective states relating to the control, appropriation, use or distribution of water used in irrigation or for municipal or other uses, or any vested right acquired therein.

Right to Amend or Repeal Law

SEC. 28. That the right to alter, amend or repeal this act is hereby expressly reserved; but no such alteration, amendment or repeal shall affect any licensee theretofore issued under the provisions of this act or the rights of any licensee thereunder.

San Francisco Rights Maintained

SEC. 29. That all acts or parts of acts inconsistent with this act are hereby repealed: Provided, that nothing herein contained shall be held or construed to modify or repeal any of the provisions of the act of Congress approved Dec. 19, 1913, granting certain rights-of-way to the city and county of San Francisco, in the State of California: Provided further, that Section 18 of an act making appropriations for the construction, repair and preservation of certain public works on rivers and harbors, and for other purposes, approved Aug. 8, 1917, is hereby repealed.



UPWARD OF 2,000,000 KW. WILL BE DEVELOPED ON GOVERNMENT LAND AS A RESULT OF THIS LEGISLATION

Metal Deposition in Arc Welding—I

Mechanism of Metal Transfer from Electrode to Plate Is Explained by the Aid of Photography —Evidence Indicates that 85 Per Cent of Metal Is Carried Across Arc in Liquid Form by Molecular Forces

By O. H. ESCHHOLZ
Research Engineer Westinghouse Electric & Manufacturing Company

THE flow of metal from a wire electrode across the arc to the surface of the fused members is distinctive of metallic electrode arc welding. The phenomena of metal transport, therefore, must be of fundamental importance in the determination of weld and circuit characteristics. As this view is receiving increasing consideration by electrode manufacturers, apparatus designers and welding engineers, the author submits a few pertinent observations with the hope of stimulating further discussion and investigation.

The conversion of electrical to thermal energy is a well-known characteristic of the arc. The concentration of this energy at the terminal of the wire electrode causes an intermittent flow of metal across the arc stream. Careful examination of the performance of a variety of bare electrode wires indicates that metal transfer may be accomplished in part by:

1. Vaporization and condensation of electrode material.
2. Expulsion of vaporized and liquefied metal by the expansion of gases confined or generated in the electrode ends.
3. Transport of liquefied metal due to the forces of molecular attraction, gravity, surface tension, adhesion, cohesion.

While all three of these means are available for the deposition of metal, it is the author's conclusion that under good welding conditions at least 85 per cent of the deposited metal is transmitted in liquid form through the action of molecular forces.

Proportion of Electrode Vaporized Is Small

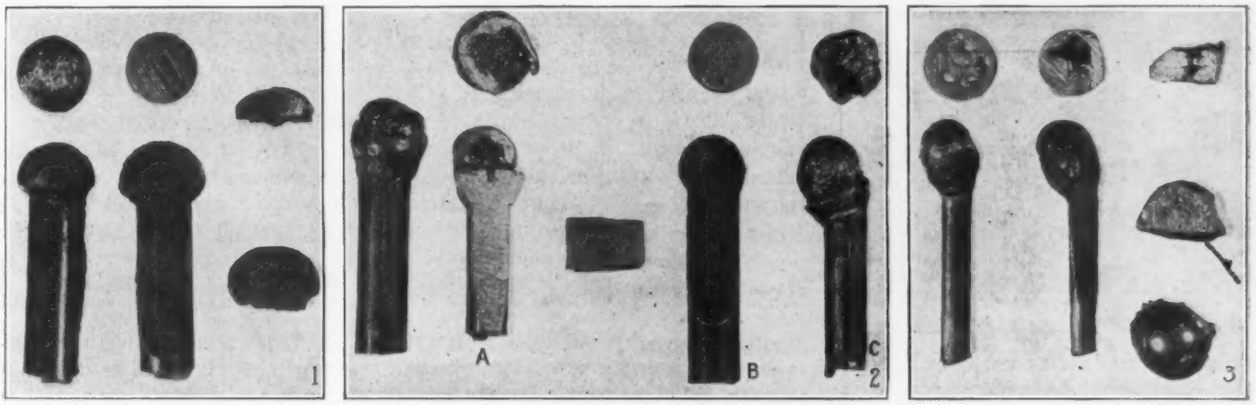
The importance of this factor may be evaluated by determining the rate at which the filler or wire electrode metal is consumed and comparing the energy absorbed at the bare wire, negative electrode terminal with that obtained by calculating the energy necessary to vaporize an equivalent amount of metal.

It has been found by test on welding with an 18-volt, 150-amp. arc that a mild steel electrode, $\frac{5}{32}$-in. (3.9 mm.) in diameter, is consumed at the rate of 3.1 lb. (1.4 kg.) per hour. The distribution of arc voltage is estimated to be as follows: Anode drop, 9 volts; cathode drop, 7 volts; arc-stream drop, 2 volts.

The energy input at the negative arc terminal is, therefore, of the order of 1,200,000 watt-seconds per pound of electrode metal. The energy required just to vaporize one pound of iron is of the order of 3,100,000 watt-seconds, assuming a boiling point of 2,450 deg. C., a latent heat of fusion of 1,120 therm-grams and a specific heat of liquid iron of 0.20. It is at once evident that under normal welding conditions only a small proportion of the electrode metal may be vaporized. Overhead welding tests in which the choice of electrodes and arc length were such as practically to eliminate metal transfer due to gas expansion or molecular attraction indicated the amount of metal deposited by condensation to be of the order of 5 per cent. A reasonable estimate of the distribution of negative arc terminal energy on welding downward appears to be as follows:

	Watt-Secs.	Energy, Per cent
Liquefaction (2,000 deg. C.) of 90 per cent of wire electrode	720,000	60
Vaporization (2,450 deg. C.) of 10 per cent of wire electrode	310,000	26
Radiation, conduction, convection losses	170,000	14
Approximate energy per pound of wire electrode consumed	1,200,000	100

This effect is present to some degree in all commercial welding wires. It is well known that metals absorb gases readily, the quantity varying greatly with their characteristics, preparation and exposure. Iron has been found to contain under some conditions fifty times



FIGS. 1 AND 2—APPEARANCE OF ELECTRODES AND GLOBULES FOR DIFFERENT MATERIALS. FIG. 3—CAVITIES PRODUCED BY SLAG AND OCCLUDED GASES IN ELECTRODES

Fig. 1—Solid section and regular globules obtained with ¼-in. drill rod. Fig. 2—Results with mild steel wire: (A) Oxidized appearance when arc is broken in air. Deposited metal, however, is solid. (B) Section free from cavities when arc is broken in inert or reducing atmosphere. (C) Arc broken in air. Well-defined line between solid and oxidized metal indicates zone of oxygen penetration. Fig. 3—The cavities formed in the deposited metal are produced by slag and gases contained in electrode.

its volume of gas. Upon striking an arc with electrodes high in occluded gas, the pressure obtained by the rapid expansion of the confined atmosphere exerts a propulsive force on the inclosing fluid metal, scattering it approximately radially from the electrode end. This may be confirmed by dipping a welding rod in an acid (H_2SO_4, HCl, etc.) for a few minutes to permit the occlusion of hydrogen and then striking an arc. An increase in the volume and agitation of arc gases, as well as scattering of metal, may be observed at once. This performance characterizes an abnormal electrode. Tests made with electrodes high in various occluded gases have failed to indicate an increased deposition rate due to the functioning of the gaseous blasts. Moreover, the emission of such blasts distinctly served to destabilize the arc stream and thereby prevent the maintenance of a short arc length, particularly essential for overhead welding.

Some electrode wires contain relatively large quantities of included iron oxide and slag. Upon heating the electrode end such impurities disintegrate and liberate oxygen, which then combines with the carbon present to form carbon monoxide and carbon dioxide. The expansion of these generated gases tends also to propel the fluid metal across the arc stream. However, again no increased deposition rate was evident during test owing to metal transferred in pellet form. It is characteristic of low carbon steels that the metal becomes pasty over a critical temperature range. This condition permits the influx of oxygen with the resultant generation and expansion of gases in the interior of the electrode terminal. This effect is obtainable, apparently, to an appreciable degree only upon welding with a long arc.

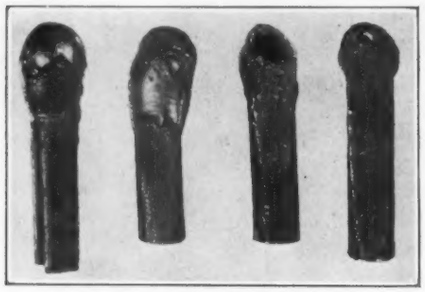


FIG. 4—RESULTS WITH LONG ARC, OXIDIZING ATMOSPHERE AND LOW-CARBON ELECTRODES

Expansion of occluded or generated gases occurs to only a slight degree when holding a short arc length with wires that comply with the specification drawn by the American Welding Society. The effect obtained is not explosive in action, but may be described as a slow enlargement of the globular electrode terminal. Expansive forces of this order appear to aid metal deposition by decreasing the forces of cohesion and surface tension retaining the globule on the end of the wire electrode. If the arc is interrupted in a neutral atmosphere the globular electrode tip may be observed to decrease in size, owing to the diffusion of confined gases and shrinking of the liquid metal.

When the use of welding wires high in occluded or generated gases is unavoidable, the arc should be stabilized by coating the electrode with a flux, increasing the circuit voltage or reactance. Metal plates, shapes, etc., are also found occasionally with a high gas content, particularly if they have been preheated in a gas furnace. This condition may be recognized by a vicious, snapping, sputtering arc, frequent arc interruption and tendency for the arc stream to move rapidly from the initial point of electrode contact. Welding conditions may be improved by the use of a very short arc, blocks of copper or like material on both sides of the zone to be welded, flux-covered electrodes and increased circuit voltage or reactance.

MOLECULAR FORCES CAUSING DEPOSITION

Most of the pencil electrode metal appears to be transported and deposited in globular, liquid form, upon either welding downward or overhead, when the electrode current density is of the order of 8,000 amp. per square inch. The metal transfer appears to be accomplished by:

A. Downward Welding (1) *Long Arc.*—Formation and growth of a liquid globule at electrode terminal until its weight, or gravitational force, exceeds the sum of the forces of surface tension and cohesion, tending to retain the globule at the electrode.

(2) *Short Arc.*—Growth of globular end until contact is made with a wetted surface (plate metal liquefied by anode energy), the forces of adhesion and surface tension at the plate surface then assisting the gravitational force in drawing the globule to the plate.

B. Overhead Welding (1) *Long Arc.*—Slight deposition due only to condensation of vaporized metal or pellet impact.

(2) *Short Arc.*—Globular growth until contact is made with liquefied plate or deposit surface, whereupon the forces of adhesion and surface tension at the plate overcome the combined forces of gravitation, cohesion and surface tension acting to hold the globule to the electrode surface.

CHARACTERISTICS OF DIFFERENT ELECTRODE MATERIALS

Globular formation at electrode terminal is characteristic of bare, coated and covered wires. The size, appearance and homogeneity of such globules vary greatly with wire analysis, diameter, covering, polarity, current density, arc length, impurities and perhaps mechanical working and heat treatment. Bare electrodes that have been examined by the author may be classified in four groups.

Group 1.—The globular formation is most evident upon welding with drill rod. As this steel is made by the crucible process, it is low in impurities and gas content. Sections through the globule show, therefore, solid metal even after holding a long arc. The high carbon content (1.2 per cent to 1.4 per cent) serves to generate a thick envelope of carbon-oxide gases which greatly reduces the further oxidation of the electrode surface, maintaining it in the approximate form visible during the welding. Such globules may be readily obtained upon drawing an arc with a drill rod $\frac{1}{8}$-in. (3.2 mm.) in diameter, using a welding current of 100 amp. and lengthening the arc stream as the globule increases in size. When a long arc, $\frac{3}{16}$ in. (4.7 mm.), is held, the electrode end enlarges until a characteristic maximum diameter is secured. At this diameter the weight of the globule equals the attractive forces holding to the electrode, so that further enlargement causes the liquefied metal to fall from the electrode end, dropping to the plate in downward welding, or flowing down the electrode in overhead welding. On holding a short arc length the growth is limited by contact with the plate surface, when the forces of surface tension and adhesion assist in metal transfer.

In Fig. 1 are shown exhibits of drill-rod globules.

The particular characteristics are regular contour, slight oxidation and solid section. In Fig. 5a* are shown both the arc stream and globular end; in Fig. 5b the globular end has been released, while in Fig. 5c globules are shown deposited on the plate with one forming at the electrode terminal. Fig. 5f shows the contour of the globule immediately after interrupting the arc, the exothermic reaction of atmospheric oxygen and surface carbon developing sufficient radiant energy to permit photographing the terminal. A slight irregularity in contour due to such oxidation may be noted.

Group 2.—Mild carbon steel is frequently employed as welding wire. Upon forming a globular end and breaking the arc atmospheric oxygen rapidly attacks the unprotected incandescent iron, often leaving only a perforated iron oxide shell. In Fig. 2a are shown typical exhibits of such oxidized globular ends. During welding, however, the metal is exposed to a much slower rate of oxidation, due to the protection offered by the inclosing gases. To obtain a true exhibit of globule conditions during welding it is necessary to cool the electrode, after interrupting the arc, in an inert atmosphere. The characteristic formation then obtained is shown in Fig. 2b. The solid section and contour now resemble those secured with drill-rod electrodes. This formation may be obtained by holding an arc from the bottom of a hole 2 in. (5.1 cm.) deep, $\frac{3}{4}$ in. (1.9 cm.) in diameter, and interrupting the welding current when the electrode is surrounded by dense arc fumes. Fig. 5d shows the small globular electrode end on welding with a short arc, while Fig. 5e shows the electrode end shortly after the release of the globule.

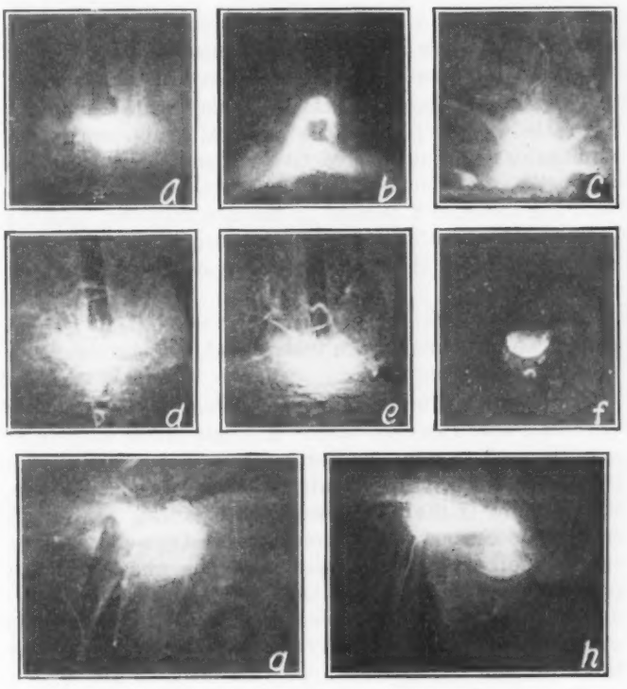


FIG. 5—APPEARANCE OF METALLIC ELECTRODE TERMINAL AND ARC STREAM

(a, b, c) Downward welding with long arc and drill rod, showing globular terminal, globule in transition and deposition. (d, e) Downward welding with short arc and mild-steel electrode, showing appearance of terminal before and after globule release. (f) End of drill-rod electrode shortly after interrupting arc. (g) Overhead welding, short arc, mild-steel electrode; note globular end, deposited layer of metal. (h) Overhead welding, long arc, mild-steel electrode; note absence of deposit, striated electrode surface caused by downward flow of liquid electrode metal.

Group 3.—The presence of occluded or generated gases is practically unavoidable in steels made by the bessemer and puddling processes. The expansion of such gases in the liquefied electrode end produced characteristic cavities in the wires examined. These cavities occurred singly or in groups, varying widely in size and distribution. Deposit tests indicated that the cavitous condition could be readily obtained in the transferred metal. Fig. 3 shows typical electrode and deposit exhibits of this group.

Group 4.—Upon breaking a long arc held with a low-carbon-content wire electrode, an interesting modification in globular structure may be obtained. It is well known that commercially pure iron passes through a critical temperature range, in the neighborhood of 950 deg. C., in which the metal assumes a pasty form. This condition obviously facilitates the penetration of atmospheric gases and therefore the formation and expansion within the fluid globular body of carbon oxide gases. This expansion causes the globule to enlarge in the typical hollow forms shown in Fig. 4. Mild steel electrodes also possess this characteristic, although to a less degree, as is shown in Fig. 2c. In the latter exhibit a distinct line of demarcation is visible between the globular shell and solid electrode, where, presumably, the critical temperature zone existed, facilitating oxygen penetration.

The structures shown in Figs. 2c and 4 are, to the author's knowledge, characteristic only of long arc welding and should not therefore occur while following correct welding procedure. This is substantiated by the fact that welds are made with either Group 2 or Group 4 electrodes, comparatively free from perceptible gas pockets.

*These photographs were obtained with the high-speed camera described by J. Legg in the December, 1919, *Electric Journal*.

Engineering Service on North Carolina Farms

PIONEER work in the extension of engineering service to farms and country communities is being carried on by the North Carolina State Highway Commission in collaboration with the Bureau of Extension of the University of North Carolina. That state is said to be the first to provide a special fund by legislative grant for such a purpose, and to aid in its promotion the university organized a new division of its extension work which has been called the "division of country home comforts and conveniences." The staff is made up of members of the university's engineering departments. In the six months since the work was organized assistance has been given directly to more than 100 persons in rural communities.

Electric light and power are chief among the conveniences that it is hoped to bring to rural sections all through the state. North Carolina has many small water-power sites, many streams scattered through the state having enough fall to develop from 1 hp. to 10 hp. of hydro-electricity. A model installation of this kind is to be made at the site of the university in Chapel Hill, where waterwheels, generators and auxiliary apparatus will be shown and explained. Farm-lighting sets have also been carefully studied with a view to aiding the farmers in their choice of apparatus. The extension of rural telephones is to be promoted. P. H. Daggett is the director of the division staff of the university.

Reactive Volt-Ampere Indicators

It Is Shown How Standard Indicating Wattmeters May Be Applied to the Measurement of Reactive Volt-Amperes by Selecting Suitable Scales and Making Proper Connections in the Circuit

By H. C. YEATON
Lynn, Mass.

THE load on a circuit is increased very little by quadrature component of the current, but the heating effect of this quadrature component should be considered carefully. In most power-plant installations it is such an important factor that it has been deemed necessary to install reactive volt-ampere indicators in order to determine the exact character of the circuits.

The best way to measure the reactive volt-amperage of a circuit is to use an electric dynamometer type of wattmeter, which has a fixed current and a movable potential coil. It is necessary only to have the wattmeter provided with a suitable scale, with a zero center preferably, and to connect it into the circuit correctly. Single-phase, two-phase and three-phase circuits are considered in detail.

The instrument should meet the following requirements:

1. The current and voltage coils should be connected 90 electrical degrees out of phase. Then the instrument will indicate 90-electrical-degrees-out-of-phase volt-amperes, or, in other words, reactive volt-amperes.

2. The instrument should have a zero-center scale in order that it may indicate the quadrature component when the current is either lagging or leading the potential.

3. As the reactive volt-amperage of a circuit probably would not be more than half the power of the circuit, a scale of one-half this power is selected for the instrument. This scale will not be satisfactory, however, if the instrument is to indicate true watts as well as reactive volt-amperes, for, obviously, the instrument should have a scale that would indicate the whole power in the circuit, when the power-factor is unity.

Single-Phase, Two-Wire Circuits.—To measure the reactive volt-amperage of a single phase, two-wire circuit, use a single-phase wattmeter having a resistance-reactance box. This box is to produce the 90 electrical degree displacement between the current coil and the potential coil. Connections of the box are shown in Fig. 1.

Unless otherwise specified, the instrument will be provided with a scale having a zero center and a range of approximately one-half of the total power in the circuit. This scale is found by the formula, Scale $= EI/_{,}$ in which E = line volts and I = line amperes.

As the reactive volt-amperes probably will not be more than one-half the total power of the circuit, the numeral 2 appears in the formula. The instrument having a zero-center scale, the torque is proportionately the same as that of a standard wattmeter without a zero-center scale.

The calibrating watts are obtained from the formula, Calibrating watts $= S/CP$, in which S = value of range of scale in volt-amperes, C = current transformer ratio and P = potential transformer ratio.

Two-Phase, Three-Wire and Four-Wire Circuits (Polyphase Instruments).—To measure the reactive volt-amperage of a two-phase, three-wire circuit or of a two-phase, four-wire circuit, a two-phase wattmeter should be employed and so connected in the circuit that the current and the voltage in each element will be 90 electrical degrees out of phase, as shown in Fig. 2 for two-phase, four-wire circuits and in Fig. 3 for two-phase, three-wire circuits.

Unless otherwise specified, the instrument will be provided with a scale having a zero center and a range of approximately one-half the total power in the circuit.

The scale is found by the formula, Scale $= 2EI/2$. There being two phases, the numeral 2 appears in the numerator—and as the reactive volt-amperage probably will not be more than one-half the total power of the circuit, the numeral 2 is used in the denominator. As the instrument has a zero center, the torque is proportionally the same as that of a standard wattmeter without a zero center.

Calibrating watts (per element) $= S/CP2$. There being two elements in the instrument, the numeral 2 is used in the denominator.

Two-Phase, Three-Wire and Four-Wire Circuits (Single-Phase Instruments).—A single-phase wattmeter may be used to measure the reactive volt-amperes of a two-phase, three-wire circuit, or of a two-phase, four-wire circuit, if the phases are well balanced. In either case it is necessary so to connect the instrument that the current coil will be in series with one phase and the potential coil will be across the other phase. These connections cause the voltage and the current in the instrument to be 90 electrical degrees out of phase. Connections for the two-phase, three-wire circuits are shown in Fig. 4 and for the two-phase, four-wire circuits in Fig. 5.

Unless otherwise specified, the instrument will be provided with a scale having a zero center and a range of approximately one-half the total power in the circuit. The scale and calibrating watts are found precisely as for the polyphase meter on the two-phase circuits. Scale $= 2EI/2$. Calibrating watts $= S/CP2$.

If a two-phase, three-wire or four-wire wattmeter is used to measure both the true watts and the reactive volt-amperes of a two-phase, three-wire circuit, or of a two-phase, four-wire circuit, the instrument should be connected as follows:

When employed as wattmeter, the current and the voltage coils of one element would be connected to one phase and the current and the voltage coils of the other element would be connected to the other phase.

When used as a reactive volt-ampere indicator, the current coil of one element would be connected to one phase and the voltage coil of the same element connected to the other phase; also, the current coil of the other element would be connected to one phase and the voltage coil of the same element would be connected to the other phase as shown in Fig. 2, thereby obtaining the 90-deg. phase displacement required.

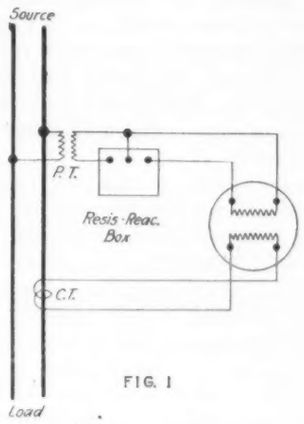


FIG. 1

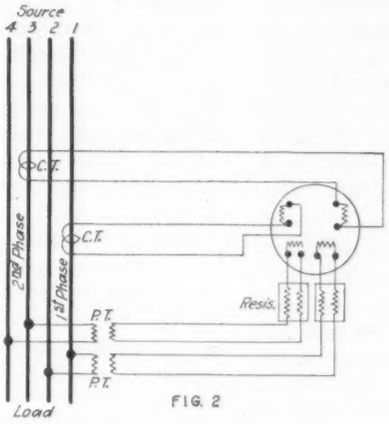


FIG. 2

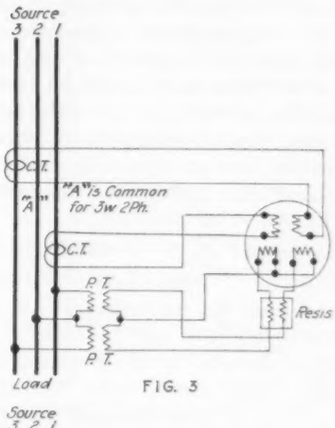


FIG. 3

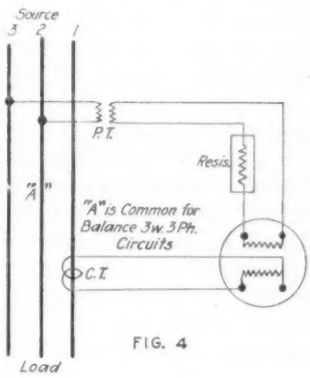


FIG. 4

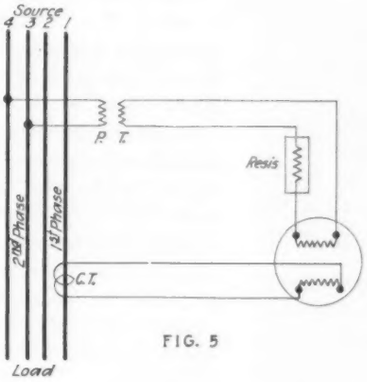


FIG. 5

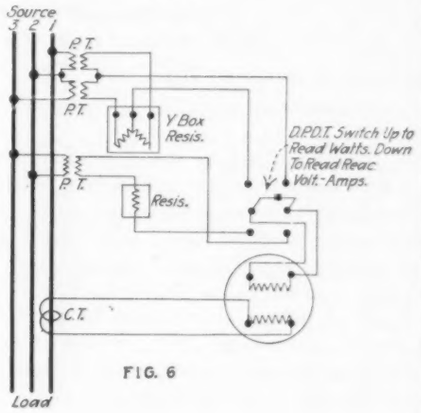


FIG. 6

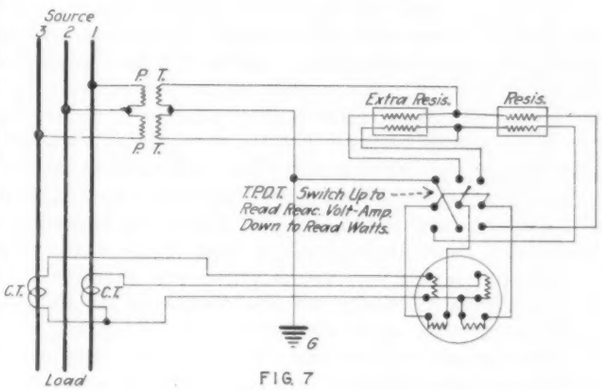


FIG. 7

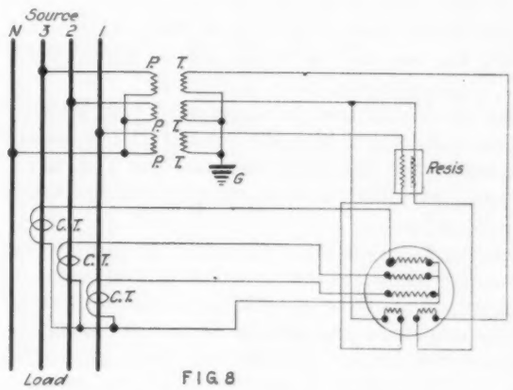


FIG. 8

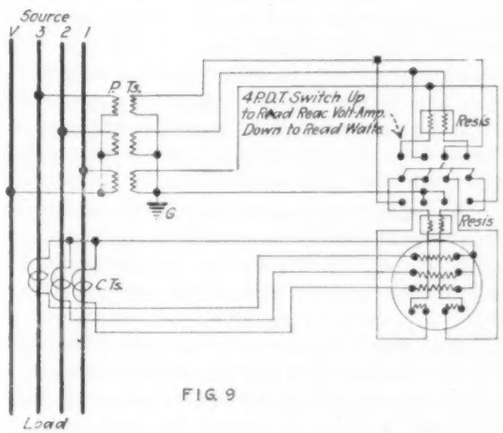


FIG. 9

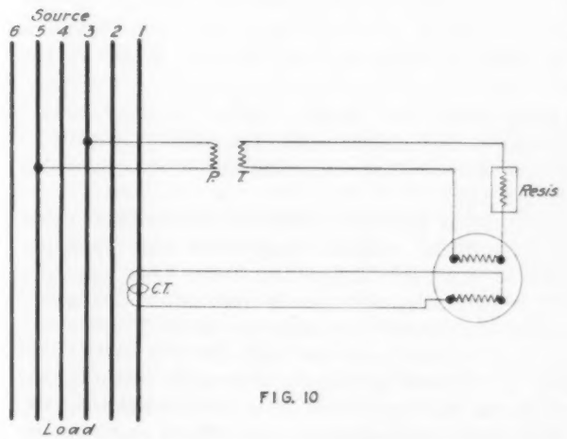


FIG. 10

CONNECTIONS FOR USING INDICATING WATTMETERS FOR THE MEASUREMENT OF REACTIVE VOLT-AMPERES

Three-Phase, Three-Wire Circuits (Single-Phase Instruments).—It is possible to measure the reactive volt-amperage of a three-phase, three-wire circuit with a single-phase wattmeter, provided the phases are well balanced. The instrument should be so connected in the circuit that the current and the voltage of the element will be 90 electrical degrees out of phase, as shown in Fig. 4. The instrument should be provided with a scale having a zero center and a range of approximately one-half the total power of the circuit.

The scale $= (EI\sqrt{3})2$, in which E = line volts and I = line amperes. There being three phases, the quantity $\sqrt{3}$ appears in the numerator. As the reactive volt-amperage probably will not be more than one-half the total power of the circuit, the numeral 2 appears in the denominator. The instrument having a zero-center scale, the torque is proportionally the same as that of a standard wattmeter without such a scale.

Calibrating watts $= S/CP\sqrt{3}$. The instrument being single-phase, the quantity $\sqrt{3}$ appears in the denominator.

If it is required to use a single-phase wattmeter to measure both true watts and the reactive volt-amperes of a balanced three-phase, three-wire circuit, two resistance boxes must be used with the instrument—a box for reading reactive volt-amperes and a box for reading the true watts, as shown in Fig. 6.

Such an instrument would be provided with a scale having a zero center and a range of approximately the total power of the circuit, since it would be used to indicate also the true watts in the circuit.

The scale is found by the formula, Scale $= \sqrt{3}EI$. When the instrument is used as a reactive volt-ampere indicator, the calibrating watts are obtained from the formula, Calibrating watts $= S/CP\sqrt{3}$.

To use the instrument for measuring true watts, it is necessary to have a Y box, the amount of the resistance in each leg of the box being expressed as follows: Resistance of instrument used as reactive volt-ampere indicator divided by $\sqrt{3}$.

Three-Phase, Three-Wire Circuits (Polyphase Instruments).—To measure the reactive volt-amperes of a three-phase, three-wire circuit, a polyphase wattmeter should be employed and should be so connected in the circuit that the current and the voltage in each element will be 90 electrical degrees out of phase, as seen in Fig. 3. Unless otherwise specified, the instrument will be provided with a scale having a zero center and a range of approximately one-half the total power of the circuit.

The scale should be: Scale $= EI\sqrt{3}/2$. The instrument having a zero-center scale, the torque is, proportionally the same as that of a standard wattmeter without such a scale.

The calibrating watts are obtained from either of the following formulas: Calibrating watts (per element) $= S/CP2 \times 0.85$, or, Calibrating watts (per element) $= S/CP2$. The latter formula is used when the resistance of the instrument has been increased 15 per cent. This method is considered the best, for the instrument is simply a standard polyphase wattmeter with 15 per cent additional resistance, and it is easy to have a polyphase wattmeter for measuring true watts and reactive volt-amperes. Fig. 7 shows the necessary connections.

A polyphase wattmeter employed to measure the true watts and the reactive volt-amperage of a three-phase, three-wire circuit has the external resistance in two boxes so that it is only necessary to change boxes by means of a three-pole, double-throw switch, as in Fig. 7.

The switch in one position throws in the extra resistance box, which contains 15 per cent more resistance than the total resistance of the instrument and other resistance box. This position adapts the instrument for reading reactive volt-amperes.

Three-Phase, Four-Wire Circuits (Polyphase Instruments).—If an instrument is needed to measure the reactive volt-amperage of a three-phase, four-wire circuit, a three-phase, four-wire wattmeter should be employed and be connected in the circuit as shown in Fig. 8. Unless otherwise specified, the instrument will be provided with a scale having a zero center and a range of approximately one-half the total power of the circuit.

The scale is found by the formula, Scale $= 3EI/2$, in which E = neutral volts and I = line amperes. The numeral 3 appears in this numerator as in the numerator of the ordinary scale formula for four-wire, three-phase circuits.

Calibrating watts (per element) $= S/CP4\sqrt{3}$. This formula resembles that used to determine the calibrating watts of a wattmeter used to measure the true power in a four-wire, three-phase circuit. It differs in containing the quantity $\sqrt{3}$, used because the potential circuits of the elements are connected across the legs of the circuits; or, in other words, the delta voltage is impressed upon the instrument instead of the Y voltage which is used for the standard four-wire, three-phase wattmeter.

To measure both the true watts and the reactive volt-amperes of a four-wire, three-phase circuit, use a three-phase, four-wire wattmeter. Make the connections as shown in Fig. 9. When the instrument is used as a wattmeter it should have a scale capable of measuring the total power of the circuit and should have also a zero center, because the wattmeter will have to indicate volt-amperes with the current either leading or lagging.

As in the case of the ordinary four-wire, three-phase wattmeter, the scale is obtained from the formula, Scale $= 3EI$, in which E = volts and I = line amperes.

The calibrating watts are obtained from the formula, Calibrating watts (per element) $= S/CP4$.

From the above description it can be seen that, as the instrument now stands, it is a standard four-wire, three-phase wattmeter with a zero-center scale. If this instrument is to measure the reactive volt-amperage of the circuit, connect the instrument in the circuit so that the current and the voltage of each element are 90 electrical degrees out of phase. These connections are shown in Fig. 9. The potential coils have to be connected across the delta voltage of the circuit, thereby increasing the voltage across the instrument in the proportion of $\sqrt{3}$: 1. Therefore, by increasing the resistance of the instrument 73 per cent (using another box) and connecting the instrument in the circuit, as shown in Fig. 7, it will indicate either true watts or reactive volt-amperes.

Six-Phase, Six-Wire Circuits (Single-Phase Instruments).—To measure the reactive volt-amperes of a six-phase, six-wire circuit, if the phases are well balanced, a single-phase wattmeter should be used and so connected in the circuit that the current and voltage of the element are 90 electrical degrees out of phase, as shown in Fig. 10.

Unless otherwise specified, the instrument will be provided with a scale having a zero center and a range of approximately one-half the total power of the circuit.

The scale is found as follows: Scale $= \sqrt{3}EI2/2$, in which E = line volts and I = line amperes. The instrument having a zero-center scale, the torque is proportionally the same as that of a standard wattmeter without such a scale.

The calibrating watts are obtained from the formula. Calibrating watts $= S/CP2\sqrt{3}$.

Testing Insulators for Resistance to Thermal Changes

Weathering and Storage Tests of Suspension Insulators Show that Temperature Changes Are Serious Cause of Failures

IMPORTANT tests of suspension insulator units conducted by Prof. Harris J. Ryan at Leland Stanford Junior University during the last four years were reported at the recent National Electric Light Association convention at Pasadena. These tests indicate that the effect of temperature change is a most serious cause of insulator failure and that the quality of porcelain is of even greater importance than electrical design. While there has been a decided improvement in suspension insulators during recent years, the weathering tests indicate that some tests should be devised to subject insulators to thermal fatigue in a brief period of time. The importance of such research work and testing in connection with insulator design and manufacture is emphasized by the results given in the accompanying table.

The insulators used in the tests are of a variety of types and makes, some having seen service on the lines of Western companies while others were taken directly from factory shipments. It is interesting to note the high percentage of failures of the different types when the insulators are not subjected to either voltage or mechanical load but simply to weather conditions. These test results tend to emphasize several points which have been clearly established by tests and operating experience.

The majority of suspension insulator failures, especially among units manufactured during the last six years, have been due to temperature changes, voltage duty and loading in most cases having very little effect. From the table it will be noted that insulators 1-13A, LA, BL and S, after four years of yard treatment, following their previous service record, show a rate of failure of from 12½ per cent to 15 per cent per annum for the four-year period. This test checks with what has been found under service conditions with the same class of insulators on Western transmission lines.

It is also interesting to note at this point that where insulators of the class mentioned above were placed in even temperature storage the rate of depreciation was materially reduced and in some cases was negligible. For example: The 1-13A class insulators over a 750-day period were failing at a rate of 43.8 per cent under yard treatment, while the rate of failure under basement treatment was only 4.35 per cent. With the LA insulators the failure under yard treatment was 36.8 per cent, while under basement treatment the failure was 0 per cent. The BL class failed under the last period of yard treatment at 47.4 per cent, while under basement treatment the failure was only 9.52 per cent. The S lot had a failure under yard treatment of 29.4 per cent and a failure under basement treatment of 3.85 per cent.

From the table it will be noted that under the first period of basement treatment the difference in number of failures between yard and basement treatment was not considerable, but after a continuation of two years it was quite pronounced. This basement treatment explains to a large extent the reason why insulators installed in stations have given good service while the same kind of units installed on lines have been the source of a great amount of trouble.

It is also of interest to note the difference between LA and B insulators. Both were manufactured by the same company, one in 1912 and the other in 1916. One shows a 60 per cent depreciation in four years of yard treatment and the other no depreciation. These facts

SUSPENSION TYPE INSULATOR TESTS

Series	A	1-13A	LA	B	BL	C	F	G	H	J	Q1	Q2	S	Total
Date of manufacture	1912	1912	1912	1916	1913	1913	1917	1908	1916	1916	1916	1916	1912	
Total insulators received for test	74	92	98	58	92	82	..	59	15	92	47	47	102	858
Failed prior to yard treatment	0	15	19	1	8	13	..	2	0	0	0	3	11	72
Available for yard treatment, December 1916	74	77	79	57	84	69	..	57	15	92	47	44	91	786
Failed after 195 days' yard treatment, June 1917	0	10	21	0	18	5	..	0	0	2	4	9	24	93
Percentage of failure, yard treatment	0	13.0	26.6	0	21.5	7.2	..	0	0	2.2	8.5	20.4	26.4	
Available for test, June 1917	74	67	58	57	66	64	21	57	15	90	43	35	67	714
Withdrawn from test	0	0	1	0	0	1	0	0	0	0	0	0	2	4
Continued in yard treatment, June 1917	74	34	29	57	33	32	21	57	15	90	43	35	33	553
Failed after 115 days' yard treatment, October 1917	1	15	10	0	13	4	1	0	0	1	4	8	12	69
Percentage of failure, yard treatment	1.35	44.1	34.5	0	39.3	12.5	5.23	0	0	1.11	9.3	22.8	36.4	
Started basement treatment, June 1917	0	33	28	0	33	31	0	0	0	0	0	0	32	157
Failed after 115 days' basement treatment	..	10	9	..	12	2	..	..	..	..	..	..	6	39
Percentage of failures, basement treatment	..	30.4	32.1	..	36.4	6.45	..	..	..	..	..	..	18.7	
Available for test, October 1917	73	42	38	57	41	57	20	57	15	89	39	27	47	602
Withdrawn from test	2	3	0	1	1	4	2	2	2	0	15		4	36
Continued in yard treatment, October 1917	71	16	19	56	19	24	18	55	13	89	51		17	448
Failed after 750 days' yard treatment, December 1919	3	7	7	0	9	3	9	2	3	1	0		5	49
Percentage of failure, yard treatment	4.23	43.8	36.8	0	47.4	12.5	50.0	3.64	23.1	1.12	0		29.4	
Continued in basement treatment, October 1917	..	23	19	..	21	29	..	..	..	..	..		26	118
Failed after 750 days' basement treatment	..	1	0	..	2	2	..	..	..	..	..		1	6
Percentage of failure, basement treatment	..	4.35	0	..	9.52	6.90	..	..	..	..	..		3.85	
Insulators starting yard treatment	74	77	79	57	84	69	21	57	15	92	91		91	807
Total withdrawals	2	3	1	1	1	5	2	2	2	0	15**		6	40
Insulators to figure in percentages	72	74*	78*	56	83*	64*	19	55	13	92	76		85*	767
Total failures	4	43	47	0	54	16	10	2	3	4	25		48	256
Percentage of failure	5.6	58.2	60.3	0	65.1	25.0	52.6	3.6	23.1	4.4	32.9		56.5	33.3

Average duration of yard treatment was 1060 days.

*Groups marked with a star had half their number in the basement for an average of 865 days.

**These insulators failed under repeated tests at very short intervals.

are borne out by practice as well as test, as insulators made in 1914 of the B class show no depreciation after more than five years of line service, while insulators made one to two years prior to that time show a depreciation of from 6 per cent to 10 per cent per annum under service conditions.

The record of insulators marked G is gratifying, as these units were manufactured in the early stages of the suspension insulator art—1907 and 1908—doing duty under severe line conditions on 100-kv. circuits up to 1914, when they were removed from the line and shortly afterward sent to the laboratory for test. This insulator is of poor electrical design, having a low margin of safety between flash-over and puncture. The distribution of stresses is not well taken care of as with units of later design, as heavy streamers form under flash-over conditions, cracking the porcelain bodies by excessive heating. In spite of such defects, these insulators show only a 3.6 per cent depreciation during the four years yard treatment. It must be remembered that these units are the old cap and stud type, using cement. The surfaces are untreated, no gaskets or yielding material having been used in their assembly. This simply emphasizes the fact that a high grade of porcelain is more essential in the suspension insulator unit than good electrical design. It also indicates the fact that with proper care good life can be obtained from insulators of the cap and stud type.

It will be noted that type H insulators made in 1916 by the same manufacturer as the G group show a much higher rate of depreciation. These records tend to show the relatively greater merits of the units which were manufactured by the same company eight years previously.

Another point clearly brought out by the tabulated results concerns insulators marked F. These units were not made of porcelain, but of a fused material which is molded while in a liquid state and the hardware attached by cement in the usual manner, or an alloy is used. Regarding the difference between cement and alloy, the results would indicate no particular preference, but it is clearly shown that any material having a mortality of over 50 per cent in two years of yard treatment is inherently unfit for service, either because of improper design or other deficiency.

Severe Service for Dead-End Units

The results, taken as a whole, seem to indicate clearly why insulators next to the tower in suspension strings and those used in dead-end positions have a higher rate of depreciation than other units. That is, these particular units pass through wider daily and seasonal temperature ranges than the other units, as the one in suspension next to the tower is a sunshade for the others. In stations insulators are protected both from extreme temperature variations and from absorbing moisture, hence these insulators give better service, all of which is shown by laboratory and field results.

All tests to date seem to establish clearly that thermal fatigue is apparently the major factor in suspension insulator deterioration. Therefore it seems logical that some method should be devised to develop a test whereby suspension units could be given, in a comparatively short interval of time, an aging effect equivalent to that of from ten to fifteen years' service.

The tests were reported by the sub-committee on suspension insulator research, of which J. A. Koonte, Jr., is chairman. The committee feels that these tests should be continued and investigations made to predetermine, where possible, the effectiveness of insulator improvements.

Vacuum Cleaner to Remove Dust from Indirect Lighting Fixtures

WITH the idea of providing adequate illumination which at the same time will not expose over-bright sources of light, the Emporium, one of the largest department stores of San Francisco some time ago adopted the indirect system of lighting. The results have been most satisfactory, but the system employed has brought up several problems in the maintenance of efficiency which were not involved in the former system using translucent globes.

The fixtures in use, designed by Louis C. Mullgardt, are novel in that when they are lighted the inverted bowls seem to be made of marble and apparently contain a lamp bulb. In reality, however, they are made

INDIRECT LIGHTING SYSTEM IN DEPARTMENT STORE

of plaster of paris so perforated that the light shines through to illuminate the under surface of the dome-like shape and gives the effect of translucency. The resulting fixture is inexpensive and most artistic in appearance and still gives the amount of light required in a store with high ceilings.

It was soon found, however, that the problem of cleaning was essential to good results but difficult to handle. The lamps are exposed to the air in a trough on the upper surface of the fixture, in a position where they collect dust. Tests revealed that the light given off grew gradually less and less on account of the dust until it ceased to be sufficient for the exacting demands of department-store service. At first an attempt was made to dust the fixtures carefully once a month, using a long ladder and an ordinary duster in the process. The record of broken filaments, however, soon showed that this policy was unsatisfactory. Next a bellows was used to better effect. This removed the dust sufficiently without breaking so many lamps in the process, but the difficulties attending the use of a ladder still remained. At the present time the Emporium is planning to adopt a vacuum cleaner operated from a ladder that can be moved from place to place from above. The ladder can be folded up when not in use.

Why Utilities Pay High Rates for Money*

Conditions Surrounding the Issues of Bonds—Financing by Short-Term Notes Condemned—Preferred and Common Stock Issues Placed with Local Investors Provide the Most Desirable Solution of the Problem—Educating the Public

By HENRY D. THRALL
Vice-president Minnesota Loan & Trust Company

IMMEDIATELY after the armistice the United States entered upon a program of commercial expansion unparalleled in history. It was our ambition to wrest at once from all competitors a large portion of foreign trade. At the same time, home demands were unprecedented along certain lines, especially that class of commodities which are generally known as luxuries, particularly the automobile trade. There was a steadily growing demand for capital, due partially to the expansion of trade and partially to the decreased purchasing power of money, which increased the cost of doing business. These demands have very recently reached their peak, the credit machinery of the country has been unprepared to carry this unexpected overload, and the reserves of the banking system have been materially reduced. At the present moment our financial institutions find themselves in the position of forcing liquidation for the purpose of checking this expansion in certain lines and allowing the development of other industries perhaps more necessary for the good of the people and whose development must be given earnest consideration if the country is to show an even, well-balanced growth.

Among the principal industries of the country coming under this head are the public utilities. Industrial growth cannot take place merely through financial acceleration. There must at all times be a corresponding increase in materials, man and machinery power. The public utilities of the country have been called on more and more of late to furnish the necessary sinews controlling this industrial machinery, without the ability on their part to satisfy this demand satisfactorily. The staggering demand for capital due to the industrial growth and the unprecedented earnings of many corporations extending over a period of years has bid up the price of free money to a point where those interested in public utilities must necessarily give earnest thought to the present and future needs of their companies. In addition, there are certain internal conditions of the public utilities of this country that add to the burden.

Changes Wrought in Last Few Years

Up to only a few years ago—I think, to be exact, about the year 1916—the credit of the public utilities was as good as that of any other corporations in the country. Franchises were very readily obtained. Light and power facilities as we know them now were still in the novelty stage in a great many places. Earnings were good. Money was easily borrowed on long-time securities at from 5 to 5½ per cent. The issues of good light and power companies were in demand all over the country. There was a great deal of exploitation. Companies were bought up everywhere, developed and resold to more comprehensive holding corporations.

A condition of this sort is always dangerous, as it finally results in an overexpansion and in abuse of credits. Eventually this to some extent happened. The market was oversaturated, and in some few cases corporations took advantage of their borrowing opportunities—made loans on their prospective profits rather than actual earnings—and the great investing public turned to new fields for outlets for its money. At the same time the politicians began a concentrated effort to reduce rates, talk of municipal ownership was heard everywhere, and credits fell still lower.

Fortunately for the light and power companies, earnings have on the whole not declined. In fact, the trend as shown by statistics is an increase. This increase is not, however, sufficient to justify the re-establishment of credit in the eyes of the public.

Public Utility Security Situation

There are two usual forms of credit advances to public utility companies, the bond and the short-time note. Up through the year 1918 it was very easy for a sound corporation to get long-time financing done on from a 5 to 5½ per cent basis. Many of the 5 per cent bonds of well-known utility companies were selling even at a premium, whereas the same bonds may today be selling on a 7 per cent basis or even lower. This decline in price is not entirely due to market conditions. A great deal of the change is due to the fact that the people know that in order to keep up with the growth of the country vast sums of money must be spent in the next few years on utilities, that they cannot maintain their present condition without the expenditure of these amounts, and that in the face of existing conditions it would be impossible to finance future expenditures on a paying conservative basis.

Perhaps I can best illustrate this by an example. A few years ago it was quite customary to finance construction on a large and well-managed property on a baisis of 80 per cent of cost. Five per cent interest was the usual rate on first mortgage bonds. Twice the interest charges was assumed to be sufficient margin of safety for loan purposes. Now, assuming that cost of construction and interest rates have gone up proportionately since that time, I would say that a corresponding interest rate today would be at least 7 per cent. Therefore, based on our proposition, if cost of construction is increased proportionately to the cost of money, 140 per cent would be the cost of construction today as compared with the old cost.

It is true that net earnings of the utilities of the country as a whole have probably increased to some extent. However, the large increase has unquestionably been with the hydro-electric companies and not with those companies that generate with steam. This differentiation must be borne in mind in considering the general increased net earnings. The hydro-electric companies have been especially fortunate in their position during this period of high cost of production by

*Part of an address on the financial situation as it affects public utilities, made before the first annual convention of the North Central Electric Association at Minneapolis, Minn., June 15-18.

coal. Furthermore, it is very questionable whether, taking the country over, the amounts set aside by the corporations for maintenance, renewals and depreciation have been increased proportionately to the rise in costs, so that it is very doubtful whether the average net earnings of light and power companies show an actual increase. The balance left after interest is all the funds that the company has available to take care of proper sinking funds and to pay dividends. This amount should be greater today than ever before because of the increased risk of doing business.

The bondholders always want to know that the stockholders are well taken care of. It is not their desire to run any chance of becoming the operators of the company. In view of these conditions is it surprising that the bond buyers of public utilities as a class, who in the main are individuals, have turned their attention to those securities that can show net earnings of several times interest requirements for a period of several years past?

High money rates always tend to shorten the maturity of issues; consequently the most popular recent form of financing has been securities in so-called short-term note issues, maturing usually in from one to ten years.

Public utilities through necessity have in some cases financed themselves by a certain amount of these notes. In the opinion of the banker, however, they are not a legitimate type of financing for utilities. The presumption of any note is that it will be paid when due, and most industrial corporations which have financed in this way have been in position to meet maturities either through liquidation of assets or through earnings. The public utility, however, has nothing with which to liquidate. Its holdings are presumed to be continuous, and the issuance of short-time notes in any except limited quantities means that they are merely a makeshift and will have to be refunded at maturity or converted into some other form of security. This is a dangerous procedure, especially under the conditions through which we have recently passed, as we have seen that there is at the present time a very effective blockade on the avenues for credit financing of utilities. In addition, the cost is prohibitive.

OWNERSHIP SECURITIES RECOMMENDED

The most practical method left for obtaining money at the present time seems to be through ownership securities. By ownership securities I refer to stocks, either preferred or common. In the early days before the period of exploitation this was the usual method of financing companies, and perhaps under present conditions it is the best method to pursue. The logical type of financing is the preferred stock, a very customary method. However, the preferred-stock market has also been overdone for outside investors, and in the open market at the present time it is difficult to underwrite an issue.

Temporarily the financing of utilities by large underwritings in outside markets is in abeyance, and you will find yourselves relying upon the local interest of your community to stand by you and supply you with the money necessary to build up your properties, which are such an essential factor in its prosperity.

I believe it will be a blessing in disguise for you and your communities for you to have to devise means of interesting your local investors in your properties. You will get more than their financial support, you will receive their moral help. Their suggestions will be most opportune and their confidence and influence may be the very means of helping your companies over many of your obstacles. There certainly should be much less talk of municipal ownership, complaints of poor service will be reduced, and the community itself will be behind your organization to put it in shape to compete with organizations of similarly situated and competitive municipalities.

INTERESTING LOCAL INVESTORS

Perhaps in order to interest your communities it may be necessary to offer something more than a mere promise of say 7 per cent. It may be necessary to give them a participating preferred stock, paying them a definite rate of dividends and giving them an interest in the accrued earnings of the company over and above this amount, or possibly it may even be desirable to sell them some common stock or a combination of common and preferred. But whatever means is necessary to accomplish the purpose I feel sure will in the end justify the cost.

So much for the methods of financing as they appear at the present. I think it is very safe to assume that the time when property can be purchased with an idea of building it up and reselling it at an immediate profit has passed. Those conditions only exist when there is cheap money. The task before the public utility operator is one of personal application to his property. The management is the greatest element in the success of any proposition, and careful, efficient management is what the bankers will look for when your properties again command the credit which should be theirs.

In the question of management no one thing is of more importance than the careful analysis of earnings statements. It is a mistake to fool yourselves with exaggerated ideas of net income. Net earnings of a corporation on paper and in fact may show two very different sets of figures. The conservative operator will provide sufficient funds to guard against all contingencies. He will not skimp his depreciation charge, consoling himself with the idea that the value of his property has appreciated sufficiently to offset the usual wear and tear and obsolescence. He will remember that while his depreciation may be figured on original costs, nevertheless his replacements may have to be paid for at present prices, and unless the proper amounts have been set aside for this purpose, when the day of reckoning comes the statement will disappoint no one so much as it will himself.

I have had a good deal to say regarding the duty of the public utility to the community it serves. Now just a word regarding the duty of the people to the utilities of the country. You have seen the changes the decrease in the purchasing value of a dollar has caused in the costs of operation and the costs of construction and extension of properties.

There has been, in fact, an increase in everything except rates. When the people thoroughly realize that your copper costs twice what it did a few years ago, your labor is more than double what it used to be, and the price of coal is rising as fast as the thermometer on a July day—in fact, that you have to pay two dollars today for that for which previously you paid one dollar—they will at the same time realize that it is not a fair proposition for them to pay you one dollar today for the same amount of that commodity that they paid you one dollar for five or six years ago.

Economies Obtained in Burning Oil

Best Recorded Results Were Obtained in Three Arizona Stations—Flue Gas Analysis and Temperature Are Good Measures of Efficiency—Importance of Air Regulation and Keeping Tubes Clean

By ROBERT SIBLEY and C. H. DELANY

WHEN a boiler is fired with oil there are no ashes to carry away unburned fuel, there are no banked fires to cause poor efficiency at light loads, and as it is possible to secure perfect combustion with very little excess air, the efficiency of an oil-fired boiler is naturally higher than that of a coal-fired boiler.

In the tabulated data submitted herewith is given a table of the results of actual tests that have been made from time to time on oil-fired boilers at different locations and under various conditions. These tests give the best results that can be expected from oil-fired boilers under operating conditions. Actual results obtained in regular operation are not usually so good as the results obtained from tests, but they can be made as good if the same care is exercised in keeping the boilers clean, regulating the air supply and looking after all the minor details.

There are very few data available to show just how closely modern power plants approximate to test results in every-day operation, as there are few plants that keep records complete enough and accurate enough to determine the daily boiler efficiency separately from the complete plant efficiency. The usual method of recording the daily efficiency of an oil-burning central station is by the ratio of kilowatt-hours generated to barrels of oil burned. While this is an excellent method of determining the over-all efficiency of the plant as a whole, it is a poor method of comparing an oil-burning plant with a coal-burning plant or of comparing one oil-burning plant with another. There are so many factors that enter into the over-all efficiency that the mere statement of kilowatt-hours generated per barrel of oil does not give much idea of what efficiency is being obtained from the oil-burning boilers unless a complete detailed description of the plant is included.

The best recorded results of oil-burning plants are those obtained at the three Arizona plants described in C. R. Weymouth's paper, entitled "Economy of Certain Arizona Steam-Electric Power Plants Using Oil Fuel," presented at the June, 1919, meeting of the American Society of Mechanical Engineers. This paper shows that a plant having 6,000-kw. turbines operating with a steam pressure of 175 lb. (123 kg.) and 100 deg. Fahr. (55 deg. C.) superheat and 2 in. to 3 in. (about 65 mm.) absolute back pressure generates from 257 to 294 kw.-hr. per barrel of oil. Another plant, having 250 lb. (175 kg.) steam pressure and 150 deg. Fahr. (83 deg. C.) superheat and 1.66 in. to 2.14 in. (about 45 mm.) absolute back pressure, generates from 287 kw.-hr. to 326 kw.-hr. per barrel of oil. Monthly boiler-room records of the former plant show combined net efficiency of boilers and economizers of approximately 83 per cent, which corresponds to 79½ per cent net efficiency for the boilers alone.

It is probable that the general average of present-day oil-burning central stations generate from 200 kw.-hr. to 240 kw.-hr. per barrel of oil when operated at a fair load factor. This is equivalent to from 25,000 to 30,000 B.t.u. per kilowatt-hour. At very light loads, such as occur in standby service, the efficiency may drop to less than 100 kw.-hr. per barrel.

While records giving the actual efficiency of oil-fired boilers under regular operating conditions are rare, a very close approximation of the performance of the boilers can be obtained from the flue-gas analysis and the temperature of the escaping gases. It will therefore be of interest to note some of the actual Orsat readings taken from boilers in regular service.

The following readings were obtained from a 600-hp. Stirling boiler with a Peabody-Hammel furnace. No special adjustments were made and the object of taking these readings was to obtain some idea of the performance of the boiler as it is usually fired:

	CO_2	O	CO	Per Cent Excess Air Calculated
	13.8	3.0	0	16
	14.2	2.1	0.1	12.5
	14.0	2.2	0	14
	12.0	5.2	0	32
Average,	13.5	3.1	0.02	18.6

The following readings were obtained from a 750-hp. boiler of the water-leg (Heine) type, with vertical baffles and burners set in the front wall:

	CO_2	O	CO	Per Cent Excess Air
	11.4	5.4	0	39
	12.2	4.5	0	30
	12.0	4.8	0	32
	12.3	4.5	0	29
Average,	11.9	4.8	0	32

At this point an effort was made to reduce the excess air by partly closing the damper, after which the following readings were obtained:

CO_2	O	CO	Per Cent Excess Air
13.6	2.8	0	17

The following readings were obtained from a 773-hp. Parker boiler with horizontal baffles with the burners set in the front wall, the furnace extending the full length of the boiler:

CO_2	O	CO	Per Cent Excess Air
14.9	1.2	0.2	7
15.4	0.5	0.9	4

Since these readings show the presence of carbon monoxide (CO), an effort was made to obtain perfect combustion by opening the damper and ashpit doors wide, with the following result:

CO_2	O	CO	Per Cent Excess Air
15.2	0.6	0.5	5

Since CO was still present, the fires were cut down, slightly reducing the capacity of the boiler, with the following result:

CO_2	O	CO	Per Cent Excess Air
14.3	2.4	0	12

TABLE I—RESULTS OF TESTS ON OIL-BURNING BOILERS

	Redondo, Cal.		Fruitvale, Cal.	San Francisco, Cal.		Oakland, Cal.		Handley, Tex.		Inspiration, Ariz.	
Type of boiler	B. & W.	B. & W.	Parker	B. & W.	B. & W.	Parker	Parker	B. & W.	B. & W.	Stirling	Stirling
Type of oil burner	Hammel	Hammel	Owens	Hammel	Hammel	S. & P.	Owens	Hammel	Hammel	.....	.....
Heating surface, sq.ft.	6,042	6,042	6,080	3,500	3,500	7,734	7,734	6,000	6,000	7,129	7,129
Date	8/11/10	9/5/10	3/18/11	2/9/12	2/10/12	2/24/12	2/26/12	6/25/14	6/27/14	5/29/15	6/4/15
Duration, hours	7	7	10	10	10	8	8	9	9	10	6
Gravity of oil at 60 deg. Fahr., deg. Baumé	13.3	12.9	15.37	.....	.....	14.32	14.32	25.9	26.3	.....	.....
Specific gravity of oil at 60 deg. Fahr.	.....	.....	0.9627	.....	.....	.....	.....	.....	.....	.....	.....
Steam pressure (gage), lb. per sq.in.	184.7	184.9	179.7	179.6	179.8	185.3	194.2	148.5	161.3	187.4	182.3
Oil pressure at burner, lb. per sq.in.	25.4	61.6	92	.....	.....	50.4	126	.....	.....	22	9
Temperature of feed water, deg. Fahr.	93.4	101.2	123.4	188.1	195.6	169.1	172	187.6	209.5	210.15	191
Temperature of oil at burner, deg. Fahr.	142.3	141.7	113	.....	.....	96	90	.....	.....	187.8	186
Temperature of gases leaving boiler, deg. Fahr.	406.2	537.5	394	433	.....	370	440	426.8	507.6	470.5	389.8
Draft between damper and boiler, in. water	0.044	0.230	0.15	.....	.....	0.34	0.48	0.035	0.46	0.076	0.020
Draft in furnace, in. water	0.014	0.188	+0.016	.....	.....	0.06	0.057	0.02	0.20	.....	.....
Draft in ashpit, in. water	0.046	0.471	0.02	.....	.....	0.06	0.08	.....	.....	.....	.....
Degree of superheat, deg. Fahr.	83.7	144.3	181.7	.....	.....	148	161.5	81.6	125.7	122.1	111.0
Per cent of water in oil	0.4	0.6	0.6	0.11	0.12	0.7	0.5	.....	.....	0.49	0.49
Oil free from water per hour, lb.	1,439	2,869	1,401	812.3	1,546.3	1,872	3,043	1,312*	2,355*	1,666	905
Evaporation per hour from and at 212 deg., lb.	22,639	40,375	22,422	12,600	22,273	30,227	46,380	.....	.....	26,159	14,564
Evaporation per hour from and at 212 deg. per square feet of heating surface, lb.	3.75	6.68	3.69	3.6	6.37	3.9	6.0	3.56	6.18	3.67	2.04
Rated capacity of boiler, b.hp.	604	604	645	350	350	773	773	600	600	712.9	712.9
Percentage of rated capacity developed, per cent.	108.6	193.8	100.8	102.8	182.6	113.3	173.8	103	179	106.7	59.2
Evaporation from and at 212 deg. per pound from water oil free, pound	15.73	14.07	16.01	15.53	14.43	16.14	15.24	16.27*	15.80*	15.70	16.1
Per cent of total steam used by burner, per cent	2.4	2.13	4.16	1.41	0.97	.....	.....	2.03	1.97	.....	.....
Net evaporation from and at 212 deg. per pound, from water oil free, pound	15.35	13.77	15.35	15.31	14.28	.....	.....	15.94*	15.49*	.....	.....
Calorific value of 1 lb. oil as received, B.t.u.	18,253	17,985	18,569	18,496	18,496	18,621	18,658	19,276	19,280	18,540	18,540
Calorific value of 1 lb. of oil free from water, B.t.u.	18,326	18,093	18,681	18,516	18,519	18,752	18,752	.....	.....	18,631	18,631
Efficiency of boiler and furnace, per cent	83.3	75.4	83.17	81.4	75.5	83.53	78.86	81.9	79.5	81.76	83.74
Net efficiency (deducting steam used by burner), per cent	81.3	74.0	79.8	80.2	74.8	.....	.....	80.3	77.9	.....	.....
Carbon dioxide (CO_2), per cent	14.3	12.1	13.5	.....	.....	14.3	14.6	14.0	13.5	14.5	14.5
Oxygen (O), per cent	1.8	6.8	.....	.....	.....	.....	.....	.....	.....	2.3	2.1
Carbon monoxide (CO), per cent	.....	.....	.....	.....	.....	.....	.....	.....	.....	Trace	.....

* Oil as fired.

It is thus seen that with boilers of several different types and different furnace arrangements very little effort is required by operators to obtain air regulation corresponding to the test results shown in Table I.

The temperature of the escaping gases, another important item affecting the efficiency of the boilers in regular operation, depends on five things: (a) Regulation of air supply; (b) cleanliness of the boiler; (c) capacity of the boiler; (d) design of the boiler, and (e) condition of the boiler brickwork and baffles.

Flue-gas temperatures in actual practice run all the way from 400 deg. Fahr (204 deg. C.) for clean boilers operating at their rated capacity with 15 or 20 per cent of excess air, up to 800 deg. Fahr. (426 deg. C.) for dirty boilers with leaky baffles operating at 200 per cent of rating with 50 to 100 per cent excess air. A general average for boilers in regular operation is about 550 deg. Fahr. (287 deg. C.).

The following results were obtained on a 524-hp. Babcock & Wilcox boiler set with the front headers 9 ft. (2.7 m.) above the floor, equipped with a Peabody furnace. The setting was new, and the boiler had just been cleared inside and out. The boiler is equipped with soot blowers which were operated about eight hours before the observations were taken.

	A	B
Duration of test, hours	1	3
Capacity, per cent of rating (measured by steam flow meter)	110	172
Steam pressure, gage (lb. per sq.in.)	192	198
Degrees of superheat (deg. Fahr.)	75	73
Draft at damper (in water)	0.01	0.23
Carbon dioxide CO_2 (per cent)	14.4	14.3
Temperature escaping gases (deg. Fahr.)	431.5	457.5

The importance of keeping a boiler clean is well illustrated by the effect on the flue-gas temperature of blowing the soot off the tubes. There is a common belief that when burning oil there is little or no accumulation of soot. This, however, is not the case; for while the quantity of soot is much less than in a coal-fired boiler, it is still an ever-present evil, and it is necessary to dust the tubes at least once a day if the best efficiency is to be obtained. The readings given in Table II, taken in regular service on an 823-hp. Stirling boiler with a Peabody-Hammel oil furnace, show that blowing the soot off the tubes resulted in reducing the exit temperature more than 75 deg. and that in five days the temperature gradually built up to more than it had been before the tubes were dusted.

TABLE II—EFFECT OF REMOVING SOOT FROM TUBES

Tubes dusted after the first set of readings and boiler operated for six days without further use of the soot blowers. (Oil fuel.)

Date, 1916	Draft (In.)		Capacity	Breeching Temp. (Deg. Fahr.)	CO_2	O	CO
	Furnace	Third Pass	Per Cent of Rating				
Mar. 24, a.m.	0.08	0.35	145	650	15.5	0.5	0.0
Mar. 24, p. m.	*	*	*	*	.....	.....	.....
Mar. 24, p.m.	0.07	0.33	143	574	14.5	2.2	0.0
Mar. 25, ...	0.08	0.34	141	594	14.7	1.6	0.0
Mar. 27, ...	0.07	0.37	144	607	15.0	1.05	0.0
Mar. 28, ...	0.08	0.43	146	635	14.1	2.0	0.0
Mar. 29, ...	0.08	0.37	142	637	14.9	1.05	0.05
Mar. 30, ...	0.08	0.40	142	668	15.2	1.0	0.05

* Tubes dusted.

In standby plants using oil-fired boilers contrasted with the banking of coal-fired boilers at no load the fire is put out completely, and when the steam pressure in the boiler has dropped as low as permissible the fire is relighted and the steam brought back to full pressure. During the time the fire is out the damper may be shut tight, thus materially reducing the loss of heat to the chimney during this period. Tests have shown that the oil required to keep a boiler hot in this manner amounts to from 1.5 to 3 per cent of the quantity of oil required to operate the boiler at its rated capacity. The tighter the damper the less oil will be required. In a boiler with good tight dampers the less oil will be required. In a boiler with good tight dampers the drop in steam pressure will be not more than 10 lb. or 15 lb. (0.7 kg. to 1 kg.) per hour.

Readers' Views and Comments

Need of Accurate Records on Causes of Fires

To the Editor of the ELECTRICAL WORLD:

SIR: Your editorial in the May 22 issue of the ELECTRICAL WORLD in regard to accurate reports on electrical wiring as cause for fires may give interest to the following facts.

In this town of 5,000 people three fires have quite recently been reported as caused by defective electric wiring. In the first case there was no electric wire within thirty feet of the place where the fire originated. The real cause was "booze" and cigarette stubs; in the second case the fire originated in a little catch-all cupboard over the furnace under the floor, and in the third place the proprietor of a tailor shop left his electric tailor's goose connected and went home to bed. The last-mentioned fire is the only one in which the cause could be even remotely charged to electricity.

The men who made these reports do not know the difference between a fuse plug and a spark plug and made the reports to shield the owners from their own carelessness. If all the reports referred to in your editorial are as lacking in truth as the above, a most serious injustice to the safety and reliability of electric service has been done. CHARLES T. MCCUTCHEN.

Boyne City Electric Company,
Boyne City, Mich.

Pulverized Coal for Steam Generation

To the Editor of the ELECTRICAL WORLD:

SIR: The writer has read with considerable interest the remarks published in the May 15 issue of the ELECTRICAL WORLD by T. A. Marsh, chief engineer of the Green Engineering Company. Since Mr. Marsh is directly interested in the manufacture of stokers, one can readily understand his reasons for criticising pulverized-coal-burning equipment. Any stoker concern would naturally argue along the same line, although its officials might know nothing at all about the use or cost of preparing pulverized coal.

In the first paragraph of Mr. Marsh's remarks he states that he believes it fundamentally wrong to take coal and burn it in a powdered condition. The writer takes exception to this statement, for it certainly is better and easier to burn coal in pulverized form than in lumps on grates subjected to the action of the heat.

In his second paragraph Mr. Marsh states that some accurate way of measuring the ash discharged from the stacks from pulverized-coal-fired furnaces should be found before definite statements concerning it are made. It is true that a large percentage of the ash from pulverized-coal-fired furnaces will be discharged from the stack. The percentage, however, dissipated from a first-class installation equipped with economizers and settling chambers will not be sufficient to cause a complaint, as has already been shown by installations using pulverized coal in thickly populated districts. This question of ash dissipation depends largely upon the velocity of the gases passing through the setting, and the percentage would naturally vary according to the operating conditions and the general design of the installation, the same as ash discharged from a stoker installation would vary according to the conditions under which the stoker is operated.

In the fourth paragraph Mr. Marsh states that the cement industry has more data on the subject of pulverized coal than steam producers. This statement is absolutely correct, and we do not hesitate to state that we are in touch with practically every plant in the United States and Canada and in fact have data on what is being done in connection with pulverized coal in the cement industry. We are positive that any one who at the present time is operating his coal plant at a cost as high as $1 per ton to prepare the coal is not operating efficiently, unless the particular coal plant has a very small capacity and is operated only periodically.

In order to show just what the cost of preparing coal is at the present time, we should like to state that during the month of August, 1919, at the plant of the Allentown Portland Cement Company 2,976 gross tons of coal were pulverized. The actual cost of pulverizing, in cents per gross ton, was as follows: Drying, 8.04; grinding, 8.74; operation, 0.43; power, 17.93; labor, 3.68; repairs, 7.65, or a total of 46.47 cents.

This is equivalent to 41 cents per net ton, no interest or depreciation included. This figure can be taken as representing the average cost in Portland cement plants in the Lehigh Valley district, for the quantity of coal pulverized daily from which these figures are taken is low, and no doubt in larger plants even these figures would be modified materially. The cost of preparing coal will vary primarily according to the quantity of coal pulverized daily, so that any general statements or criticisms that are made as to the cost of pulverizing coal in one plant have no bearing on the subject as a whole.

Fuller Engineering Company, H. G. BARNHURST,
Allentown, Pa. Chief Engineer.

The Rangeley Lakes Storage Reservoirs

To the Editor of the ELECTRICAL WORLD:

SIR: In your recent issue of March 20, on page 662, two photographs of "Two Sources of Potential Power in New England" appear with the statement: "These streams, the Kennebago and Cupsuptic, feed the Rangeley Lakes—a great natural reservoir that some day, like other Maine lakes, may serve as control for the flow of flash streams."

Permit me to say that the Rangeley Lakes system is and has been for several years the most highly developed system of storage reservoirs that there is in the East and probably in the whole country. This system of storage provides the Androscoggin River and the several power installations thereon—the greatest of which is at Rumford, Me.—with a stream-flow regulation unequaled anywhere in the whole United States.

To put it in more definite figures, 29,000,000,000 cu.ft. of water is stored in this system and its flow regulated over a total developed fall of more than 700 ft., or, in other words, the equivalent of approximately 350,000,000 kw.-hr. per year is given to the power plants on the Androscoggin River. C. T. MAYNARD,

Rumford Falls Power Company, Engineer.
Rumford, Me.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Distributing Three-Phase and Two-Phase Energy Over Same Lines

TO MAKE both two-phase and three-phase energy available to customers who were changing over motors from two-phase to three-phase, the scheme shown herewith was adopted by the Dayton (Ohio) Power & Light Company. This changing over was made necessary in a small town which this company recently began to serve where a two-phase, four-wire system was originally installed, the standard installation of the company being three-phase. The change was made in two

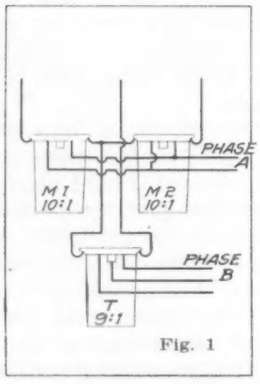


Fig. 1

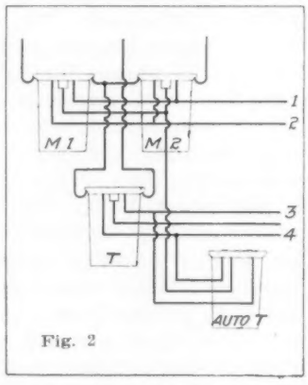


Fig. 2

TRANSFORMER CONNECTIONS USED WHILE CHANGING SYSTEM FROM TWO-PHASE TO THREE-PHASE

Either two-phase or three-phase may be taken from secondary in Fig. 2.

steps. First, the distribution system was changed to three-phase, necessitating a two-phase transformer connection at each power service; second, the motors were reconnected internally for three-phase operation.

The temporary Scott transformation from three-phase to two-phase was made easy by using the ten-to-one transformers of the old system in combination with nine-to-one transformers used by the company. The primary coils of the two original transformers were connected for 1,100 volts, and the two transformers were connected in series on the primary side and in parallel on the low-tension side, as shown in Fig. 1. This served as the main transformer of the Scott connection and for the teaser a nine-to-one ratio transformer was hung in an adjacent position and one high-tension terminal was connected between the two main transformers, the other terminal being connected to the line. The two-phase voltage with this combination was slightly unbalanced, the teaser phase being 4 per cent lower than the main phase, but this slight difference was not noticed in the operation of the motors.

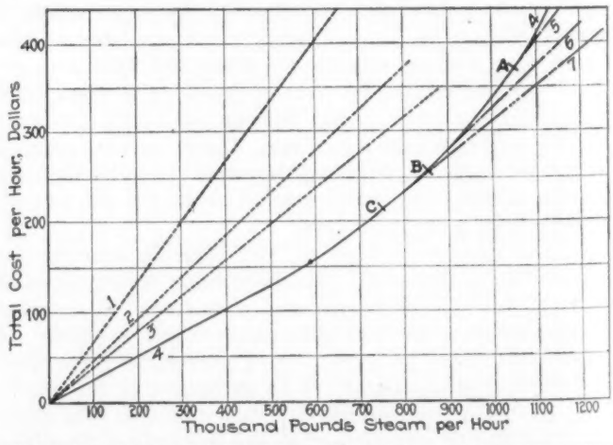
While the motors of the customers were being reconnected for three-phase operation, it was desirable to have both two-phase and three-phase energy available at the same time. This was accomplished over the old distribution lines by connecting an auto-transformer, as shown in Fig. 2, to the secondary of the connection shown in Fig. 1. This auto-transformer was an ordinary 220-volt transformer from the secondary of which a tap was brought out, giving 86.6 per cent voltage, and this tap was connected to the neutral of the main transformer while the ends of the 220-volt winding were connected to the secondaries of the teaser transformer. By this connection it was possible to operate a two-phase motor on leads 1, 2, 3 and 4 at the same time that a three-phase motor was operating on 1, 2 and 3.

This scheme operated successfully until all the motors were reconnected, when the transformer banks were changed to three-phase connections and nine-to-one ratio transformers were used to give a higher secondary voltage.

J. K. HIMES,
Superintendent of Distribution.
Dayton Power & Light Company,
Dayton, Ohio.

Charts That Show Combinations of Boilers and Stokers to Use for Any Load

IN ORDER that its boiler-room force may use the most economical combination of boiler equipment for any load, a large central station with chain grates and underfeed stokers has developed the set of curves here reproduced. These curves give cost of operating different combinations of boilers at any load and for various periods of time. The operating cost includes coal of 10,400 B.t.u. per pound (1,185 cal. per kg.) at $3.50 per



OPERATING COST CURVES FOR CHAIN GRATES AND UNDERFEED STOKERS

(1) One-hour operation at 150 per cent rating of thirty-two 518-hp. Edge Moor boilers with chain grates but without economizers. (2) Four-hour operation; same boilers and rating. (3) Continuous operation; same boilers and rating. (4) Continuous operation of twenty-four 558-hp. Edge Moor boilers with underfeed stokers and forced draft. Twenty of these boilers had economizers and four had not. This combination is most economical for continuous loads up to the point *C*. (5) Combination of the two groups of boilers for loads lasting one hour. Underfeed group should be used alone until load passes *A*. (6) Combination of both groups of boilers for loads lasting four hours. Chain-grate boilers should not be used until load gets beyond *B*. (7) Combination of both groups of boilers for continuous operation with loads in excess of the point *C*.

ton ($3.86 per metric ton), firemen at $120 per month and the maintenance of the refractories required for the different boilers for which the curves were drawn.

The curves show that for most conditions of operation the boilers equipped with underfeed stokers (No. 4) are much cheaper to operate than Nos. 1, 2 and 3, those in which chain grates are used. Curve No. 4 is not straight like Nos. 1, 2 and 3, because some of the boilers with underfeed stokers are equipped with economizers and some are not. All the chain-grate group are identically equipped. The letters *A*, *B*, and *C* on curve No. 4 indicate the points up to which the load can be most efficiently carried on the boilers equipped with underfeed stokers for two-hour, four-hour and continuous operation respectively. These three points were found in the following manner: Lines parallel to lines Nos. 1, 2 and 3 were drawn tangent to curve No. 3; then *A*, *B* and *C* were placed at the respective points of tangency.

Chicago, Ill. S. N. CLARK.

Additional Ground Wire Improves Transmission-Line Telephone

OPERATION of telephone lines run on the poles of 33,000-volt transmission lines was greatly improved by one Missouri central station by running another ground wire lower down the pole in addition to the regular overhead ground wire. The telephone line is about 4 ft. (12 m.) below the transmission line, and the lower ground wire is bracketed to the pole midway between them. Separate ground connections are run from both the upper and the lower ground wires. This lower ground wire serves as a protection from stray fields from the transmission line, thus eliminating much noise. In addition to improving the telephone service, the second ground wire protects the telephone line from falling power wires and adds materially to the strength of the line as a whole.

F. C. ARTHUR,
Superintendent of Distribution.
Empire District Electric Company,
Joplin, Mo.

Troubles Caused by Shaft Currents in Generator

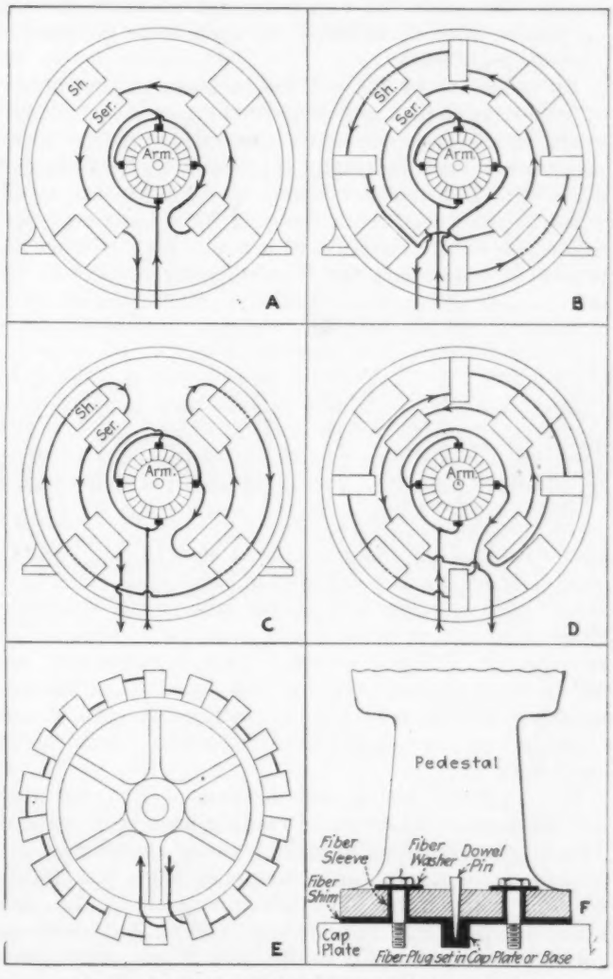
A MAGNETIZED generator shaft may cause two types of trouble. First, the simple magnetic effect which shows up in neighboring iron sometimes causes mechanical troubles such as heating of eccentrics and improper action of dash-pots and Corliss valve gear. Second, the shaft acts as a unipolar armature and a voltage is generated in it which is always in the same direction and depends on the amount of magnetization and on the speed. The consequent current may cause trouble in the bearings and pitting of the shaft.

The causes of shaft magnetization are shown in the accompanying sketches. In a plain compound machine (sketch A) the series coils are usually connected in such a way that the series current makes one complete turn around the shaft. This is the simplest way to connect up the series field, and usually no damage results, as the magnetizing effect is comparatively small. This series turn causes the shaft magnetism often observed in compound machines. Interpole compound machines are susceptible to the same trouble in worse form, as in them there is the possibility of two turns around the shaft (see B), and if the series field happens to have two coils per pole connected in series there is a chance of three turns. Alternating-current generators and synchronous motors may show the same effect owing to the rotor current. (See E.)

In large high-speed machines it has been common to insulate one bearing to avoid this trouble. (See F.)

With engine-driven alternators there is no good way to insulate one bearing, but as the rotor current is not heavy enough to cause much magnetization and shaft voltage, the trouble seldom is such as to require any treatment.

In direct-current machines with stationary fields the extra connectors needed to connect the series and interpole windings in such a way as to avoid magnetizing the shaft stand still and are therefore not objectionable. A plain compound machine could be connected like sketch C. An interpole machine connected like D would not magnetize the shaft except in cases where series or interpole windings are shunted heavily, and even then it would amount to little. In direct-current machines the shunt-field current also goes around the frame once or twice and has a slight tendency to magnetize the shaft, but its effect is not heavy enough to be noticeable.



CAUSES OF SHAFT MAGNETISM AND CONNECTIONS TO PREVENT IT

Shaft magnetism may be caused by series field connectors making one turn around the shaft as in the compound machine in "A," or making two turns as in "B," an interpole machine. In "C" and "D" are the respective methods of avoiding this trouble. "E" shows shaft magnetizing current in an alternator or synchronous motor. "F" shows a bearing insulated to prevent shaft currents.

Cleveland, Ohio. JAMES DIXON.

Bonus System Increased Number of Meters Read by 50 Per Cent

THREE bonus systems for meter readers described here have proved successful in the case of the companies using them. The first is a "quantity" bonus system, by which the average number of meters read in a day has been increased over 50 per cent. This system was started in 1917 and the rates since October, 1918, have been $75 per month for a daily average of 250 meters, plus a bonus of 50 cents for each increase of one in the daily average above 250, the average to be based on the month's work and the maximum wage to be $100 per month. By this plan the daily average of 300 meters gives a bonus of $25, or the maximum wage of $100. The following deductions are made from the bonus: 50 cents for each per cent above 7 per cent on meters missed; 50 cents for each error detected on rereading the meter.

By reference to Table I the increase in the number of meters read in a month after the bonus was inaugurated will be seen. While the salary of the meter readers has been increased approximately 100 per cent over 1916, this increase would, no doubt, owing to the greater cost of labor in general, have been necessary regardless of the adoption of a bonus plan. Under the present arrangement, the regular meter readers do not

TABLE I—INCREASE IN NUMBER OF METERS READ UNDER BONUS SYSTEM

	No. of Regular Readers Employed	Meters Read by Regular Readers	Daily Average	Per Cent Missed First Call	Bonus Paid
October 1916*	8	25,464	192	5	*
October 1917	5	24,272	278	7	$70.50
October 1918	5	25,216	276	6	88.00
October 1919	5	27,679	316	7	125.00

* Bonus plan not used.

as a rule read any meters missed at first call, but this work is done by two other men, who read "misses or skips" each morning and deliver bills in the afternoon. These men are at present paid a straight wage of approximately $75 per month. This arrangement was not in force during 1916, but has no effect on the previously reported daily average, which was and is now computed on the elapsed time for routes, based on an eight-hour day.

By using this bonus plan the rate of labor turnover and the number of errors in reading have been reduced. This also has an effect in making easier handling of customers' accounts in the commercial office and in decreasing complaints. The bonus applies on the combined total of gas and electric meters, but does not apply to five suburban routes that cover about twice the territory of the regular city routes. The regular city routes were analyzed as to distance covered and number of meters, and the division of routes was made as equably as possible among the various readers. The "meter read" slip is so arranged that the meter reader is furnished with the previous month's reading only and does not have the consumption for months past to guide him in case he tries "curbstone" readings. When a man is suspected of this practice a few dummy slips are inserted the next time he goes over a route. Only two readers (both extra men) have tried the practice, and they were quickly detected.

By the second system referred to above the cost of reading a meter is only 1.3 cents, although it was 1.5 cents six years ago, when the readers were on a flat salary. This decrease has taken place in spite of the great general increase in labor costs since that time. Moreover, a better class of meter readers is now attracted. The plan is simply that meter readers (who read both gas and electric meters) shall receive 1.3 cents per meter read with a penalty of 10 cents for every error. If they are on special work or absent on account of sickness, they are allowed $2 per day without any bonus. Their earnings average approximately $125 per month.

The third plan, a "quality" plan, is based on the accuracy of the readings. By this plan the same men read the meters every working day in the month and in addition to their regular salary receive a bonus de-

TABLE II—BONUS FOR ACCURACY IN READING METERS

Percentage of Meters Read Correctly	Bonus per Month	Percentage of Meters Read Correctly	Bonus per Month
100	$7.50	94-95	$4.00
98-99	6.00	92-93	3.00
96-97	5.00	90-91	2.00

pending upon the accuracy of their readings. A meter reader who is 100 per cent efficient—that is, whose readings are all correct—receives a bonus of $7.50 for the month. If his readings are from 98 to 99 per cent correct, he receives $6, and so on down to 90 per cent, as Table II shows. If a meter reader after he has become familiar with the work falls below 90 per cent, he is replaced by a new man. In addition to this bonus the meter reader at the end of the year who has the highest rating receives an extra bonus of $25. To qualify for the month rating a meter reader must have worked three-quarters of the working days in the month. If a meter reader is late in reporting ten times during the month he is not eligible to participate in the rewards.

These systems were described by the committee on bonus systems at the Pasadena convention of the National Electric Light Association.

Value of Linoleum for Insulating Mats

LINOLEUM, because of its wearing qualities, offers some advantages for use in place of rubber for insulating mats. To overcome the tendency to curl, a hole may be drilled in the floor and a wooden plug driven in. A rounded-head oval wooden pin may then be driven through the linoleum and into the plug in the floor. Some tests by George Wall, chief operator of the Buffalo General Electric Company, made at the suggestion of the Utilities Mutual Insurance Company, indicate the dielectric strengths of various brands to be as shown in the accompanying table:

Test No.	Make			Results
1	Nairn Linoleum Co.	XX	Battleship	42,500 volts for 30 sec. without breakdown
2	Nairn Linoleum Co.	XX	Battleship	Broke down at 43,000 volts
3	Nairn Linoleum Co.	XX	Battleship	Broke down at 43,000 volts
4	Nairn Linoleum Co.	X	Battleship	Broke down at 37,500 volts
5	Nairn Linoleum Co.	X	Battleship	Broke down at 27,500 volts
6	Nairn Linoleum Co.	X	Battleship	Broke down at 30,000 volts
7	Nairn Linoleum Co.	X	Battleship	20,000 volts without breakdown
8	Standard Carpet Co.	X	Regular product	Broke down at 28,000 volts
9	Standard Carpet Co.	X	Regular product	Broke down at 32,500 volts
10	Standard Carpet Co.	X	Regular product	20,000 volts without breakdown
14	S. Finck Company	X	Battleship	Broke down at 43,000 volts
15	S. Finck Company	X	Battleship	Broke down at 43,000 volts
16	S. Finck Company	X	Battleship	Broke down at 30,000 volts

An objection that may be raised to the use of linoleum for insulating mats is that it has a greater tendency than rubber to absorb moisture, thus lowering the insulating value in moist places.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Device for Threading Sleeves on Coil Terminals

BY USE of a special threading needle described here placing cotton sleeving on the lead wires of coils is made comparatively easy and simple. It is common experience that one of the most bothersome operations in finishing form-wound or spread armature coils is that of threading the lead wires through the cotton sleeves. This is particularly true when the coil is wound with two or more wires in parallel. By use of this sleeve threader much time and trouble can be saved.

NEEDLE MAKES IT EASY TO THREAD SLEEVING OVER LEAD WIRES OF COILS

To make the threading needle a piece of copper wire of diameter equal to the inside diameter of the sleeving in use and about three-quarters as long as the sleeve is cut and polished with emery cloth. A tube which will just fit on the outside of the wire is then made from thin soft copper or tin of about the same length as the wire. After this tube is put on the wire and soldered in place it is smoothed off with a fine file and emery cloth and the end of the wire is rounded. If the sleeves are to be put upon a flat wire or several wires in parallel, the tube may be flattened to fit them.

In use the armature coil leads are inserted into the hollow end of the needle and the sleeve is slipped over the rounded point and shoved over the lead wire into its proper place, after which the wires are withdrawn from the needle.

FRANK SOETE.

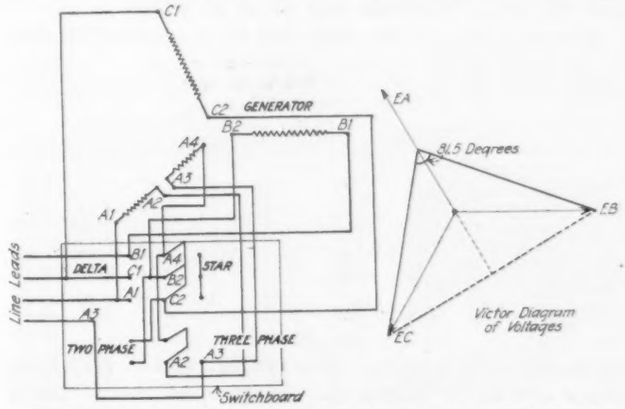
Honesdale, Pa.

Alternator for Two-Phase or Three-Phase Tests

FOR securing both two-phase and three-phase voltage one generator connected to a special small switchboard is used in an Eastern industrial plant. The method of making the connections was as follows: The alternator originally had a three-phase winding with the six leads brought out, none of which were marked. The phases were picked up by finding which pairs of leads gave a closed circuit and were then temporarily tagged *A* and *A*, *B* and *B*, and *C* and *C*. The middle point of the *A* phase was then found by counting the groups of coils in that phase. The connecting lead at this point was opened, and two leads which were permanently tagged *A2* and *A3* were brought out. The *A1* and *A4* leads were then easily found, since they formed ends of a closed coil. They were permanently tagged and the temporary *A* tags on these leads were removed. The *A4* point was considered as the star point on this leg.

To find which of the *B* legs was the star point, one of the *B* legs was connected to *A4* and the machine was run with the field excited. (*A2* and *A3* were connected together for this test.) If the voltage across *A1* and the free end of the *B* leg is 1.73 times the voltage across *A1-A4*, then the *B* leg connected to *A4* is the proper star point of the *B* leg and should be permanently marked *B2* and the free end marked *B1*. If the voltage obtained is less than 1.73 times the voltage across *A1* and *A4*, then the ends of the *B* leg should be reversed and the voltage tested again, when it should be found correct. In a similar manner the *C* legs were tagged *C1* and *C2* by connecting one end to *A4* and trying out. Having all three legs now marked, a star or delta connection can easily be made.

For the two-phase connection *C2* and *A4* are joined, and *B2* and *A2*. *C1* and *A3* will then be the legs of one of the phases and *B1* and *A1* the legs of the other phase. Drawing up a vector diagram of the voltages it is seen that the two-phase system is not exactly balanced, the two phases being 81.5 deg. apart instead of 90 deg. This is, however, close enough for ordinary purposes. An exact 90-deg. relation could be obtained by taking the points *A3* and *A1* at the proper coil, which can be calculated. It should be noted that if the coils *A1-A2* and *A3-A4* are reversed when connecting



SWITCHES AND CONNECTIONS TO OBTAIN TWO-PHASE OR THREE-PHASE VOLTAGE FROM ALTERNATOR

up two-phase, the result will be a single-phase system as shown by the dotted lines in the vector diagram.

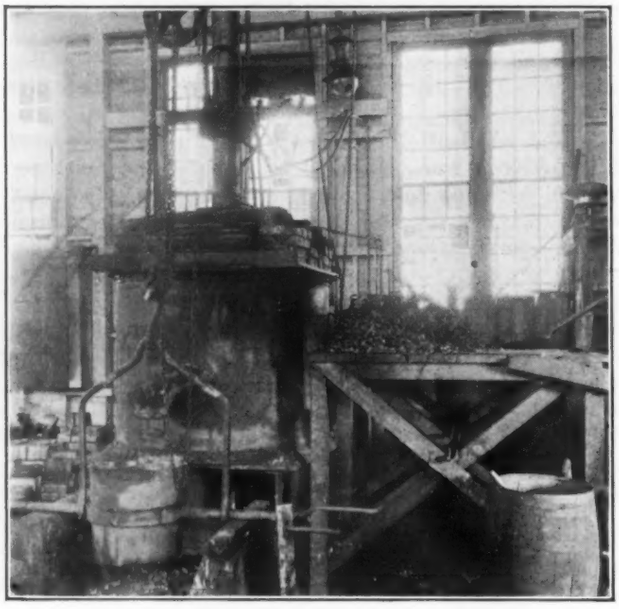
A small switchboard of treated maple with a three-pole, double-throw switch and a two-pole, double-throw switch mounted on the machine provides a convenient method of quickly converting the machine to two-phase or three-phase delta or star. The machine has been in daily service now for more than six months and has given complete satisfaction.

EUSTACE C. SOARES.

Ampere, N. J.

Manufacture of Synthetic Cast Iron in the Electric Furnace

ALTHOUGH synthetic pig iron has been produced in the electric furnace both in the United States and Canada, the production of gray iron from wrought iron and steel scrap suitable for high-grade castings on a commercial scale as described here is a recent ac-



FURNACE USED TO MAKE CAST IRON FROM STEEL SCRAP

complishment. Late in the summer of 1919 an experimental furnace of 1,000 lb. (1,600 kg.) capacity was installed at the Hesse-Martin Iron Works for this purpose. The furnace was of the single-phase type operating with a conducting hearth and a single electrode above the bath. The potential between the bath and the upper electrode was about 55 volts.

The metal was easily controlled as to composition and

ANALYSES AND TESTS OF CAST-IRON BARS MADE ELECTRICALLY FROM STEEL SCRAP.

	Test Bars, 1¼ In. Diameter, Broken on supports, 12-In. Centers.			Test Bars, 1 In. x 2 In., Broken on the Flat, 24-In. Centers.				
CC	1.11	1.14	0.98	0.90	1.07	0.77	0.87	0.79
GC	1.84	1.80	2.10	2.50	1.85	2.30	1.75	2.22
TC	2.95	2.94	2.98	3.40	2.92	3.07	2.62	3.01
S	0.018	0.014	0.014	0.01	0.016	0.02	0.023	0.023
P	0.047	0.047	0.048	0.04	0.06	0.049	0.12	0.04
Si	1.87	1.87	1.75	2.01	2.25	2.36	2.50	2.03
Mn	0.58	0.62	0.62	0.54	0.54	0.54	0.56	0.56
Transverse load, lb.	3,215	3,060	3,670	3,720	3,640	3,150	3,200	3,760
Deflection	0.15	0.14	0.17	0.62	0.53	0.52	0.45	0.63

temperature of pouring. The product was of very high grade and easily machined. Analyses of several heats and physical tests are given in the accompanying tables.

Hesse-Martin Iron Company, Portland, Ore. W. L. MORRISON. Metallurgical Engineer.

Labor-Saving Hint for Erecting an Engine-Type Alternator

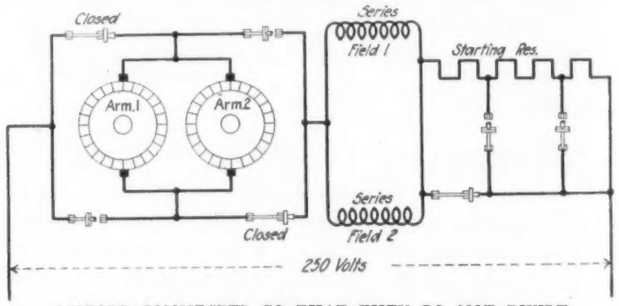
TO AVOID side shifting of the stator when erecting an engine-type alternator, the following is a useful method for replacing the stator coils removed when the stator was split for shipping. When shipping such a stator a number of coils are removed to allow the stator to be opened and shipped in separate halves. At the station where the generator is to be installed the erecting and lining up of the stator is best done before these coils are put back in place. To get access to these slots by side-shifting the stator is often undesirable. An alternative method sometimes possible is to unbolt and remove a few poles of the rotor and turn the space thus made up to the joint. This gives room to do the necessary work at the split on that side. The rotor is then turned to bring the space opposite the split on the other side and the joint coils at that side are put in. After the winding is complete the rotor can be turned to bring the open space to the bottom where the removed poles are replaced and reconnected. This is a useful trick which will often save a lot of time and work by eliminating realignment of the stator after shifting.

Cleveland, Ohio. JAMES DIXON.

Unstable Operation of Series Motors Mechanically Connected

SOME difficulty was experienced in a recent acceptance test in operating in parallel two 40-hp., 250-volt series motors mechanically interlocked and driving a 150-ton electric traveling crane. Investigation showed that separate connection to the lines in place of the original connections, as shown in the diagram, would avoid the trouble. Both motors are geared to separate shafts and mechanically interlocked through the medium of wheels and rail, hence they operate at identical speeds. After putting the bridge in motion, it was noticed that one motor was assuming practically the entire load while the other was only very lightly loaded, which suggested the possibility of the motors having widely different characteristics. Careful investigation, however, disclosed the fact that the trouble was not altogether due to dissimilar characteristics, but for the greater part to wrong motor connections.

When the motors were thrown on the line the field currents in each motor were the same, as the field resistances were equal and connected in parallel. However, some slight difference in construction allowed more current to flow through one armature than through the other. This caused a distortion and consequent weaken-



MOTORS CONNECTED SO THAT THEY DO NOT DIVIDE LOADS EQUALLY

ing of the field flux in this motor, lowering the counter emf. and allowing still greater current to flow. As a consequence this motor carried a major part of the load. This caused unstable running and general unsatisfactory operation.

The remedy was to connect each motor and its field across the line independently of the other, using separate contactors controlled from one master controller. With this arrangement the operation was successful.

Norfolk, Va. TAYLOR S. BURKE.

Two-Phase Motor Reconnected for Three-Phase Operation

IN AN article on reconnecting a two-phase motor for three-phase operation in the ELECTRICAL WORLD of May 8, 1920, page 1096, through no fault of the author, an error was made in preparing the diagram of the three-phase connection. This diagram gives a 60-deg. connection, showing one phase reversed. To correct this mistake, coil No. 2 should be connected to the star point, leaving Nos. 1, 3 and 17 for the motor leads.

115-Volt Lamps on 230-Volt Circuits in Industrial Plants

BY INSTALLING 115-volt lamps on 230-volt circuits the cost of lamps may be reduced 25 to 30 per cent in certain cases. The use of lamps of lower voltage has at least three advantages over using those of higher voltage—lower cost, greater specific output and better service performance. The following table illustrates the first two advantages:

Size of lamp in watts.....	300	1,000
Approximate price, 115 volts.....	$3.00	$7.00
Approximate price, 230 volts.....	$3.60	$8.40
Lumen rating, 115 volts.....	4,850	18,000
Lumen rating, 230 volts.....	4,100	16,100
Rated lumens per dollar: 115 volts, 1,617—2,571; 230 volts, 1,140—1,917.		

From this table it may be seen that the prices of the lamps of higher voltage are about 20 per cent greater than those of lower voltage, while, on the other hand, the light output is less by about 8½ per cent. The resultant cost per lumen for the 115-volt lamps is 71 per cent and 75 per cent, respectively, of the cost of 230-volt lamps. The third factor is of no little importance. 'Owing to the construction of the higher-voltage lamps, they are in greater danger of having the filaments broken or of having the length of life reduced by the shorting out of part of the filament.

Taking an actual condition in a certain industrial plant where the writer has done illuminating engineering, there were used 492 300-watt, 230-volt lamps costing $1,103.70. To give the same light only 415 of the 115-volt lamps would have been required. The cost of the lower-voltage lamps would have been about $919.75. Of course, this total saving could not have been realized, but it indicates the importance of the consideration.

Now, while it is cheaper to use the lower-voltage lamps, the higher-voltage circuit has an advantage due to the smaller size of conductors required. For a given amount of energy to be transmitted if the voltage be increased by 100 per cent the current will be decreased in the same proportion, and therefore the conductor need be but half as great. The advantages of the lower-voltage lamps and the higher-voltage circuits may be obtained simultaneously by operating the 115-volt lamps, two in series, across the 230-volt circuit. There is, however, a disadvantage in this arrangement in that if one lamp burns out another is not lighted. The life of lamps burned in series is also somewhat less.

Generally the lower-voltage lamps are cheaper to buy, cheaper to operate, give more light, have a longer life and are more plentiful, as the higher-voltage lamps constitute only about 7 per cent of the lamps made.

Pittsburgh, Pa. D. W. BLAKESLEE.

Color Code for Different Ratings of Refillable Fuses

FOR each rating of fuse in a St. Louis plant a different color is painted on the fiber fuse case and on the fiber cross-bar of each switch on which a fuse of this rating should be used. By this scheme it is very easy to tell the rating of a fuse which has blown, and in all probability a fuse of different rating will not be used to replace it.

As a user of refillable fuses for a number of years the writer has found that it is not good practice to let more than one or two persons do the reloading, preferably only one, if the plant is not too large. In the plant mentioned the fuse links are kept in a locker and one man is responsible for all reloading. This man is required to see that all blown fuses are refilled at the time when he comes on the job and again when he goes off the job. The blown fuses are kept in a box, and two sets of each rating already loaded are kept in a drawer.

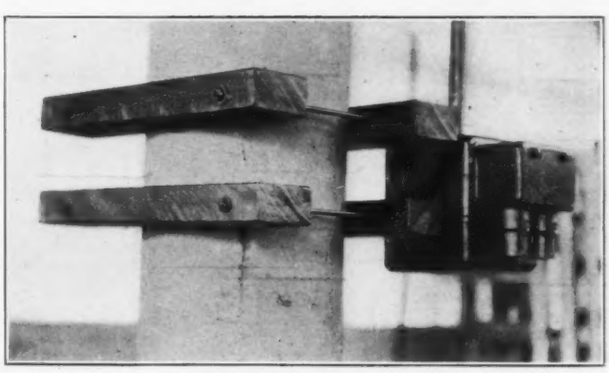
Another scheme which has saved time in tracing connections and in replacing fuses has been to stamp a number on the buses of each fuse box opposite each circuit.

Corresponding numbers are printed on a card attached on the door of each cabinet, telling what portion of the plant the circuit feeds. Thus, if the lines are dead in a certain room, by reference to this card the fuse that needs to be replaced will be found immediately.

St. Louis, Mo. G. F. KLUGMANN, JR.

Method of Mounting Four Starting Switches on One Column

BY MEANS of four strips of wood bolted to the column, as shown in the accompanying illustration, four Westinghouse No. 815 starting switches are mounted on one column in the East Springfield factory of the Westinghouse Electric & Manufacturing Company. The switches are fed through conduit which runs from above. The four strips of wood, 2 in. x 4 in. x 19 in. (5 cm. x 10 cm. x 50 cm.) in size, are placed 3¾ in. (9.5 cm.) apart vertically and 8 in. (20 cm.) horizontally. Horizontal tie rods about ⅜ in. (10 mm.) in diameter pass through the ends of each strip to hold them firmly to the column. The inside edge of each strip is slightly rounded to fit the column in order to give the strip a better seat.



METHOD FOR MOUNTING FOUR STARTING SWITCHES UPON ONE COLUMN

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Power-Factor Rate Filed at Providence

LOW power factor on the system of the Narragansett Electric Lighting Company, Providence, R. I., in installations of over 100 hp. connected load will be penalized as follows in a rate filed with the Public Utilities Commission:

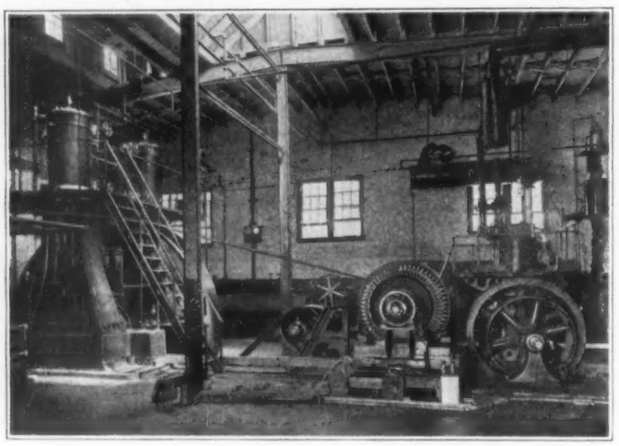
Power Factor of Customer's Load, Per Cent	Increase of Rates, Per Cent
71 to 79	5
61 to 70	15
51 to 60	25
50 and below	50

A normal power factor of at least 80 per cent is required to be maintained by the customer on week days from 7 a.m. to 6 p.m., with penalties as above stated.

Emergency Installation of Motor Shows Saving Over Gas Engine

HOW an emergency installation of a motor to replace a broken-down producer gas engine operating an ice machine increased the production of the ice plant and resulted in the ordering of a motor for permanent installation in place of the gas engine is told by Bryant White, general superintendent of the lighting and power department of the Roanoke (Va.) Railway & Electric Company, who says:

When the 200-hp. gas engine operated from a producer in the plant of the Citizens' Crystal Ice Company at Roanoke, Va., broke one of its pistons and badly



300-HP. MOTOR DISPLACING GAS ENGINE

damaged one of the cylinders the Roanoke Railway & Electric Company was asked to help out in the emergency. The only motor available was a 300-hp., 2,300-volt, 900-r.p.m. synchronous motor which was installed within twenty-four hours, as shown in the accompanying cut. This motor has been in operation for two months, and although it is of too high speed for this service and the starting condition is very severe, it has kept the plant running twenty-four hours a day, turning out 80 tons of ice daily, whereas the rating of the ice machine is only 60 tons.

William Zieber, general manager of the ice company, is responsible for the statement that the increase in ice production due to the constant operation of electric service, as compared with the producer and gas-engine source of power with its frequent interruptions, will pay two-thirds of the total power bill for operating the plant. This plant is a 125-ton refrigerator machine with tank capacity for making 80 tons of ice per day and 180,000 cu.ft. of cold storage. A 200-hp., 450 r.p.m. slip-ring motor has been ordered as a permanent installation.

Hydro-Electric Energy Saves Community More Than $500,000 in Sixteen Years

THE Indian Orchard (Mass.) hydro-electric station of the United Electric Light Company of Springfield in sixteen and one-half years saved the company and community $512,018 as compared with the cost of producing energy in the steam plant of this central station. From 1903 to 1919 the average cost of the company's output generated by steam was at the rate of $0.00777 per kilowatt-hour, whereas the average cost of the output at Indian Orchard station, on the Chicopee River, was $0.002708 per kilowatt-hour. The ratio in favor of the water-power station was 2.87 to 1. The output of the hydro-electric plant in this period was 101,167,237 kw.-hr. and that of the steam plant 227,435,383 kw.-hr., the respective total costs being $274,050 and $1,767,686. During this period the yearly output of the water-power station ranged from a minimum of 3,874,275 kw.-hr. in 1904 to a maximum of 9,325,982 kw.-hr. in 1917, and the unit cost ranged from $0.007546 in 1903 to $0.00165 in 1916. For the steam plant, which is tied in with the water-power station, the yearly output ranged from a minimum of 1,654,675 kw.-hr. in 1904 to 37,111,279 kw.-hr. in 1919. In the last fiscal year, 1919, the hydro-electric output was 8,713,520 kw.-hr., costing $0,001858 per unit, and that of the steam plant 37,111,279 kw.-hr., costing $0.0076.

These data were presented before the Massachusetts Department of Public Utilities in a hearing given the United company prior to approval of a new stock issue of 8,000 shares. The United company some years ago purchased the Indian Orchard Company, a textile manufacturing concern owning various factory and water-power privileges, about 7 miles east of Springfield, and the former gas and electric light commission denied the United company authority to issue certain stock on the ground that the ownership of an industrial concern was outside of its rights as a public utility. By a special act of the Massachusetts Legislature the United company later received authority to own and operate this industrial concern.

It was shown that by the purchase the United company had headed off the threatened competition of rival interests which were seeking to exploit the Indian Orchard water power, and that under the ownership of the United company the plant had been greatly improved and developed, resulting in the production of double the energy from the available water and the co-ordination of the service of the industrial company by day and of the United company by night to secure a twenty-four-hour use of the riv This, the company maintained, enabled the savings above recorded to be realized and has meant lower prices of energy to the community than would have been the case had steam alone been available. The improvements effected at the Indian Orchard station have been described in earlier issues of the ELECTRICAL WORLD. In granting the company's petition for stock increase the new commission did not object on the ground that the issue was related to the ownership and operation of the industrial concern.

Employee Representation in Illinois Utility

EMPLOYEES and the management of the Public Service Company of Northern Illinois have created a co-operative council to come into existence on July 1. In this council representatives elected by the employees and appointees of the management are equally represented for the purpose of considering all questions of policy which may affect the employees in any manner.

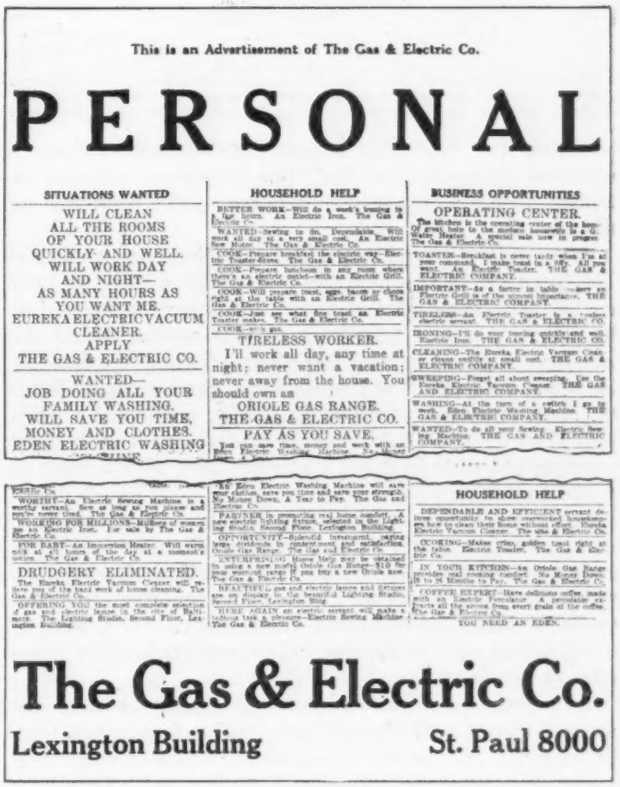
The properties of the company are divided so that there are six territorial councils, in which there is approximately one elected employee delegate for each 100 employees and not more than an equal number of delegates appointed by the company. It is provided in the constitution of the council that the elected and the appointed delegates must each vote as a unit in which the majority rules. This prevents the possibility of one elected delegate going over and voting with the appointed delegates, or *vice versa*, in order to carry a point against the combined wishes of the other delegates in his class. It is also provided that there is to be no discrimination against any employee because of his race, sect, political affiliation, membership or non-membership in any labor or other organization.

In case a territorial council cannot agree on any matter the employee or the management representatives may have the question referred to the chairman of the board of control of the company. The company is to have ten days in which either to propose a settlement or refer the matter directly to the general council, composed of an employee representative from each territorial council and not more than the same number of company representatives. Outside arbitration can be resorted to only with the consent of the representatives of both sides. If neither the board of control nor the general council is able to settle a difference in a manner satisfactory to both parties, and furthermore if either the company or its employees will not agree to an outside arbitrator, conditions are then no worse than they would have been under the old arrangement, which was devoid of any co-operative plan. However, the many opportunities for man-to-man discussion in the co-operative council are expected to result in amicable agreements being reached in every case by means provided in the constitution.

The constitution of the co-operative council was drawn up by eighteen men elected by the employees and fourteen others appointed by the management, and every word in the constitution as finally adopted was agreed to unanimously by these thirty-two men. They worked five days on the document, and J. L. Hecht, who was chairman of the convention, said that each subject was discussed until every one was satisfied as to what was the right thing to do. Furthermore, it was decided in the beginning that the co-operative council would be absolutely fair to every one and that no one should give up any existing rights.

The employee delegates who helped to draw up the constitution included five linemen, a salesman, a machinist, two service men, two gasfitters, two engineers from the general office, a wireman, a trouble man, an operator, a clerk and a collector. Some of these employee representatives were union men, but nevertheless after the second day's deliberation it was said to be impossible for an outsider to tell from the discussion which side any one man represented, especially as the employee representatives often offered more constructive suggestions than those emanating from the company's delegates. They deemed it necessary to have a clearing house in the general office to correlate the work of the six territorial councils. A committee was therefore appointed to perform this function and to supply initiative and direction where and when it may be found necessary.

Newspaper Advertising Used by Baltimore Company in Its Merchandising Campaign


This is an Advertisement of The Gas & Electric Co.

PERSONAL

SITUATIONS WANTED

WILL CLEAN ALL THE ROOMS OF YOUR HOUSE QUICKLY AND WELL. WILL WORK DAY AND NIGHT— AS MANY HOURS AS YOU WANT ME. EUREKA ELECTRIC VACUUM CLEANER. APPLY THE GAS & ELECTRIC CO.

WANTED— JOB DOING ALL YOUR FAMILY WASHING. WILL SAVE YOU TIME, MONEY AND CLOTHES. EDEN ELECTRIC WASHING

HOUSEHOLD HELP

BETTER WORK—Will do 4 week's ironing in 5 hr. hours. An Electric Iron. The Gas & Electric Co.

WANTED—Sewing to do. Dependable. Will work all day at a very small cost. An Electric Sew Motor. The Gas & Electric Co.

COOK—Prepare breakfast the electric way—Electric Toaster-Stove. The Gas & Electric Co.

COOK—Prepare luncheon in any room, where there's an electric outlet—with an Electric Grill. The Gas & Electric Co.

COOK—Will prepare hard, eggs, bacon or chops right at the table with an Electric Grill. The Gas & Electric Co.

COOK—Just see what fine toast an Electric Toaster makes. The Gas & Electric Co.

COOK—with a gas.

TIRELESS WORKER.

I'll work all day, any time at night; never want a vacation; never away from the house. You should own an

ORIOLE GAS RANGE.

THE GAS & ELECTRIC CO.

PAY AS YOU SAVE.

You can save time, money and work with an Eden Electric Washing Machine. Let your

BUSINESS OPPORTUNITIES

OPERATING CENTER.

The kitchen is the operating center of the home. Of great help to the modern housewife is a G. E. Water Heater. A special sale now in progress. The Gas & Electric Co.

TOASTER—Breakfast is never tardy when I'm at your command. I make toast in a jiffy. At your service. An Electric Toaster. THE GAS & ELECTRIC COMPANY.

IMPORTANT—As a factor in table comfort an Electric Grill is of the utmost importance. THE GAS & ELECTRIC COMPANY.

TIRELESS—An Electric Toaster is a tireless electric servant. THE GAS & ELECTRIC CO.

IRONING—I'll do your ironing quickly and well. An Electric Iron. THE GAS & ELECTRIC CO.

CLEANING—The Eureka Electric Vacuum Cleaner cleans swiftly at small cost. THE GAS & ELECTRIC COMPANY.

SWEEPING—Forget all about sweeping. Use the Eureka Electric Vacuum Cleaner. THE GAS AND ELECTRIC COMPANY.

WASHING—At the turn of a switch I do the work. An Electric Washing Machine. THE GAS & ELECTRIC COMPANY.

WANTED—To do all your Sewing. Electric Sewing Machine. THE GAS AND ELECTRIC COMPANY.

WORRY—An Electric Sewing Machine is a worry saver. Sew as long as you please and you're never tired. The Gas & Electric Co.

WORKING FOR MILLIONS—Millions of women use an Electric Iron. For sale by The Gas & Electric Co.

FOR BABY—An Immersion Heater. Will warm milk at all hours of the day at a moment's notice. The Gas & Electric Co.

DRUDGERY ELIMINATED.

The Eureka Electric Vacuum Cleaner will remove one of the hard work of house cleaning. The Gas & Electric Co.

OFFERING YOU the most complete selection of gas and electric lamps in the city of Baltimore. The Lighting Studio, Second Floor, Lexington Building.

As Eden Electric Washing Machine will save your clothes, save you time and save your strength. No Money Down. A Year to Pay. The Gas and Electric Co.

PANTRY—An electrical home comfort. A new and exclusive lighting fixture, selected in the Light Shop, Electric Floor, Lexington Building.

OPPORTUNITY—Splendid investment, earning large dividends in contentment and satisfaction. Oriole Gas Range. The Gas and Electric Co.

ENTERPRISING Home Help may be obtained by using a new model Oriole Gas Range—$10 for your present range if you buy a new Oriole now. The Gas & Electric Co.

BEAUTIFUL gas and electric lamps and fixtures are on display in the beautiful Lighting Studio, Second Floor, Lexington Bldg.

HERE AGAIN an electric servant will make a tedious task a pleasure—Electric Sewing Machine. The Gas & Electric Co.

HOUSEHOLD HELP

DEPENDABLE AND EFFICIENT servant desires opportunity to show overworked housekeepers how to clean their home without effort. Eureka Electric Vacuum Cleaner. The Gas & Electric Co.

COOKING—Makes often, golden toast right at the table. Electric Toaster. The Gas & Electric Co.

IN YOUR KITCHEN—An Oriole Gas Range provides real cooking comfort. No Money Down. Up to 24 Months to Pay. The Gas & Electric Co.

COFFEE EXPERT—Here delicious coffee, made quick as a flash. Electric percolator is prevalent among all the coffee lovers. The Gas & Electric Co.

YOU NEED AN EDEN.

The Gas & Electric Co.

Lexington Building St. Paul 8000

In its campaign to modernize housekeeping methods, the Consolidated Gas, Electric Light & Power Company of Baltimore, Md., has taken considerable space in newspapers. One of the interesting types of advertising which is being used is shown in the accompanying illustration.

House Heating by Electricity in Tacoma, Wash.

DATA on house heating by electricity showing connected load and energy consumed are given in the annual report of the municipal hydro-electric plant of Tacoma, Wash. Commissioner Ira S. Davisson of the city light department draws some interesting conclusions as to the possible growth of this class of business and its ultimate effect on the central station's generating and distribution systems. Concerning house heating the report says that for the last five years the rate for heating houses has been ½ cent per kilowatt-hour with a minimum charge of $9 per kilowatt maximum demand per year. Up to Dec. 31, 1919, only 547 customers had taken advantage of this rate. Of these 547 customers, 139 used the service twelve months, 35 having a yearly maximum demand of less than 4 kw. and the remaining 104 an average of 8.17 kw. The latter are residences which are virtually dependent upon electric heat and pay the city about $80 a year each. Where these same residences have ranges they pay an average of $45 a year more for their light and cooking. Where hot-water heaters are added this expense averages $30 a year additional, so that the complete electrically equipped house pays on an average $155 a year.

Heating data are as follows:

Number of customers, Dec. 31, 1919	547
Income from all customers—378 for only part of year	$19,448.25
Probable income if all were served the whole year	36,000
Total connected load of all customers, Dec. 31, 1919	3,625 kw.
Number of customers served for full year	139
Income from customers served for full year	$9,268.40
Total connected load of full-year customers	923 kw.
Average annual income per kilowatt of load	$10
Consumption by full-year customers	1,778,238 kw.
Average rate per kilowatt-hour	$0.0052
Number of customers using over 4 kw. a full year	103
Total connected load of full-year customers over 4 kw.	842 kw.
Average load of customers using over 4 kw.	8.17 kw.
Average load of all 547 customers	6.65 kw.

During the year the number of heating customers increased from 378 to 547, the increased interest in electric heating having been aroused by the high cost of fuel and the coal strike.

There has been no question that the city would be able to continue the heating rate of $9 a year as long as the light, cooking and power loads predominate, but the situation would take on a serious aspect should the heat load begin to exceed the other. This stage has not yet been reached but is approaching, the connected heating load now amounting to 3,625 kw. compared with a total load of 60,000 kw. The demand on the system, however, amounts to 2,700 kw., compared with a peak of 16,500 kw.

The distribution system is already being taxed in certain localities, and some extensive changes are being made to meet the situation. The fact that the network voltage is 4,000 and that there is no underground construction keeps distribution costs down. The cost of this heating service is now being analyzed. The present conclusions are:

(1) This load will come on gradually because the sawmill refuse will always keep fuel prices lower than the present rate and the customer's investment will keep many from wiring and getting heaters. This time element will give opportunity to develop the distribution along economical lines and keep the relation between the heating load and the total within bounds.

(2) Industrial heating and power used is going to increase as fast as residence heating so that the load factor will not be changed by this heating load.

(3) The fact that more efficient methods of converting fuel into electric energy are being developed must be kept in view. As this efficiency is improved it will be more efficient to distribute heat from a central heating plant by electric wires than by pipes. Central-station heating plants can now supply a congested district cheaper than many small plants in the several buildings. The amount of fuel, trucking and labor that would be saved by supplying scattered residences with central-station heat, electrically transmitted, will be much greater.

(4) An income of $155 a year from the average residence will be enough to pay the costs and make it possible to continue the heating rate now in force, with the possible modification that the ½-cent rate will not apply until the customer first pays for a fixed amount of lighting and cooking energy at their respective rates.

The percentage of income from heating customers was distributed over the year as follows: January, 16.8; February, 12; March, 11; April, 7.7; May, 5; June, 3.2; July, 2.5; August, 2.5; September, 4; October, 8.4; November,12.6; December, 14.3.

Detroit Edison Asks Customers' Help in Power Shortage

IN DETROIT the power shortage has become acute, and the Detroit Edison Company is carrying under difficulties the heaviest day load in its history. Factories with large power demands have cut down their requirements, and to further lighten the load all light and power consumers have been asked to curtail their use of energy during factory hours as much as possible. A frank statement of the company's position and a courteous appeal for assistance from customers are made in the accompanying advertisement, which is a type of publicity frequently used by the Detroit Edison Company in putting its problems before the public.

To Detroit Edison Customers

If anybody thinks that Detroit is slowing down industrially, we can tell them that we are carrying the heaviest load during factory hours that we have ever carried, and we are carrying this load under difficulties. We are short of power house capacity, because recent construction work has been delayed; first by the steel strike and then by the coal and railroad troubles, and our present equipment is worked to its fullest capacity.

The coal shortage compels us to buy in the open market and to take stuff we would not look at in normal times. Some of the coal we get is very dirty, and some of it is so acid that it burns out the linings of the furnaces.

While these conditions continue, and they will for at least another sixty or ninety days, there is always the possibility of being unable to carry the load that is put on us during factory hours. Any one of half a dozen minor troubles that, under ordinary conditions, would not affect the operating of our generating plants in the least, may be the breaking point under these conditions.

Our factory customers who are using large blocks of our power have helped us a great deal, and quickly, when we have asked them to cut down their power requirements, but we cannot put the entire burden on these big customers, and, *therefore, we ask every customer using service for either lighting or power during factory hours to be as careful as possible during the next few months.*

We do not relish continually passing these troubles out to the public, but a little care on the part of everybody will probably save every one from serious interruption of service. *Will you please help? Use only what current you really need during the day, from* 8:00 *a. m. to* 4:30 *p. m.*

THE DETROIT EDISON COMPANY

NEWSPAPER ADVERTISEMENT BY DETROIT EDISON COMPANY ASKING CUSTOMERS' AID IN POWER SHORTAGE

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Direct Current Compared with Three-Phase Current for Driving Steel Works Plant.—C. A. ABLETT.—This comparison may be summarized as follows: The three-phase system enables power to be transmitted cheaply over long distances at high voltages, but three-phase motors are not capable of speed variation without much loss of power, unless they are of a complicated and costly type, and are not well suited to many steel works purposes. Direct current is not well adapted to long-distance transmission, but in most iron and steel works this is not of great importance. Direct-current motors are capable of wide speed variation without loss of power. This renders them suitable for steel works.—London *Electrician*, May 14, 1920.

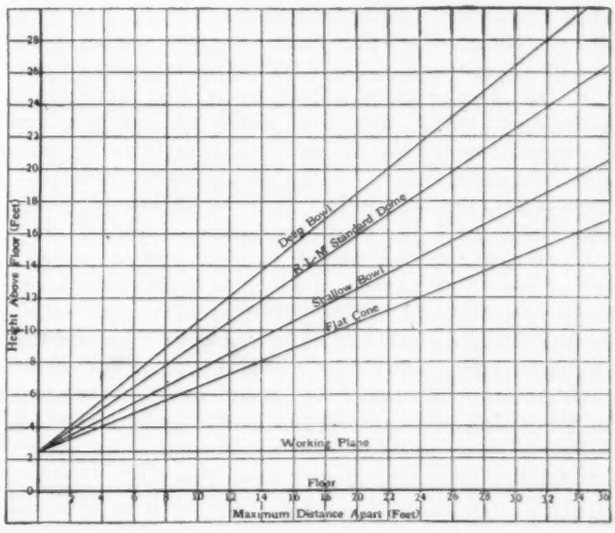
Starting Boxes for Direct-Current Motors.—F. LOPPÉ.—The author shows, by means of a series of numerical examples, that starting resistance, for cutting down the sudden current rush when starting a direct-current motor, may in certain cases be advantageously built up of resistance units successively connected in parallel instead of in series, as is usually the case. It is shown that, especially if small current steps are desirable, the weight of the resistance wire needed for a parallel-unit starting box will be considerably smaller than that of the corresponding series box, the ratio in one investigated case being 29 to 110.—*Revue Générale d'Electricité*, Jan. 17, 1920.

The Rotating Phase Advancer.—J. KOZISEK.—For the purpose of increasing the power factor of induction motors rotating phase advancers are sometimes used which consist of a stator without any winding and an ordinary direct-current armature with commutator, driven by the motor to be compensated and connected by three brushes to the rotor of the induction motor. The characteristics of this type of phase compensator are discussed in detail, particular attention being given to the question of saturation in the phase-advancer core. It is shown that certain improvements in the effectiveness of the device may be obtained by using high values of magnetic induction. Thus, in case of a core worked to high saturation, the range of unity power factor is considerably extended toward lower load values, a pronounced current minimum developing at about one-quarter of full load.—*Elektrotechnische Zeitschrift*, Jan. 15, 1920.

Lamps and Lighting

Ornamental Street Lighting.—L. A. S. WOOD.—A solution of the problem of supporting street lamps and trolley wires is offered. This new ornamental trolley pole consists of a hollow cast-iron column with brackets attached which is slipped over the existing trolley pole and is so arranged that a maximum rake in the trolley pole of 4 in. (10 cm.) can be sealed in the hollow column. Three ornamental lighting units are supported on this post. The height from the sidewalk to the light center of the top unit is 22 ft. 9 in. (6.9 m.) and the height to the light center of the side units is 18 ft. 8 in. (5.7 m.). This ornamental pole improves the appearance of the street in daylight and produces a brilliant "white-way" effect at night.—*Electric Journal*, May, 1920.

Notes on Industrial Lighting.—OTIS L. JOHNSON.—The characteristics of a good lighting system for industrial plants are outlined as follows: (1) Absence of both direct and reflected glare; (2) sufficient intensity on all working surfaces, horizontal and vertical; (3) an intensity of illumination on posts, walls and ceilings so as not to cause objectionable contrasts; (4) good diffusion; (5) light from the proper direction so as to avoid objectionable shadows. In addition to the improvements in men and women brought about by correct illumination this also results in increased production, decreased costs per unit of output, improved



RATIO OF MOUNTING HEIGHT TO SPACING FOR UNIFORM ILLUMINATION

quality, less spoilage and fewer accidents. The author concludes that the equipment necessary for a system of lighting which complies with all the requirements of good illumination can be installed and operated for less than 1 per cent of the average workman's wage. Good illumination is, therefore, not an excessive expense, but pays large dividends in proportion to the capital investment. Charts given for use in laying out lighting systems are of especial interest.—*Electric Journal*, May, 1920.

A New Low-Power Lamp Rectifier of Alternating Current.—JOHN SCOTT-TAGGART.—A rectifier was designed along the lines of an incandescent lamp which could be plugged into the ordinary alternating-current supply circuits. The rectified current is in the neigh-

borhood of 100 milliamperes. The rectifier vacuum tube operates on the principle of the Edison effect. A nickel plate was rolled into cylindrical form, and within this was placed a horseshoe filament of spiralized tungsten wire. External connections were taken from the middle point of the filament and also from the plate.—London *Electrician*, April 23, 1920.

Generation, Transmission and Distribution

Utilization of Corona Loss for Protective Purposes.—R. NAGEL.—For apparatus operating at extremely high voltages the natural corona losses represent a very effective protection against surges, simply by permitting excessive overvoltages to leak right out in the air. Through ionization of the air the effective capacity per unit length of a conductor increases greatly, when corona forms. This tends to lower the potential differences due to surging charges. The author has studied the corona phenomena of pointed conductors with a view in particular to the development of a practically useful scheme for corona protection of transmission lines of 10,000 volts up. According to a Swedish patent granted in 1911 to Centerwall, such protection is afforded by a thin wire connected in parallel to the high-tension conductor and carried in proximity to a grounded wire. An alternative scheme consists of splitting up the power conductor on short stretches into a number of parallel wires of small diameter. These suggestions are criticized, and the author instead recommends the use of barbed-wire conductors, thus taking advantage of the strong corona-forming tendency of sharp points. At 50,000 volts the corona losses on a line of commercial barbed fence wire were found to be about twenty-five times those of a similar line of smooth 5-mm. (No. 4) wire. The distance between wires was about 1.5 ft. While no corona formed below 18,000 volts, the loss on the barbed-wire line at 50,000 volts amounted to 2.5 watts per meter (0.8 watt/ft.). For practical use the author suggests special conductors of copper or aluminum provided with pointed elements of plate or wire, or for lines of larger section the use of a special barbed wire, wound around the main conductor. The line should be thus barbed on stretches about one-half mile long at points where protection is desired.—*Archiv für Elektrotechnik*, Dec. 8, 1919.

Balancing of Turbines and Propellers.—J. J. KING-SALTER.—The paper deals with the problems involved in determining the position and amount of the weight required to correct the out-of-balance, not only in propellers but in any class of turbine or electrical rotor, and gives the results of tests that have been made to endeavor to take the problem of correcting the out-of-balance from out of the realm of what was really a method of trial and error into one more nearly approaching exactitude and precision.—London *Engineering*, April 9, 1920.

Traction

Studies on Direct-Current Traction.—F. GUÉRY.—A long article on general problems in direct-current traction, such as determination of necessary power supply, utilization of the energy, and most economical lay-out of feeders, etc. The effect upon over-all efficiency of various systems of speed control and regenerative braking is discussed. The author shows how probability methods may be applied for determination of average power consumption and of peak loads due to several cars starting up at just the same time. The problem of track circuit feeder design is put on an economical basis by a modification of the Kelvin rule, but much attention is also given to considerations of maximum permissible voltage gradient along the track circuit and to corrosion difficulties.—*Revue Générale d'Electricité*, Feb. 7 and 14, 1920.

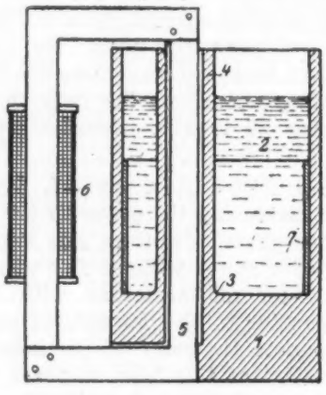
Summary of High-Voltage Direct-Current Railways.—W. D. BEARCE.—To this article is attached an extensive chart giving the details of overhead construction, power supply and rolling stock concerning fifty direct-current railway systems operating at 1,200 volts and above. This chart supersedes one published in the *General Electric Review* for November, 1916. A summary of high-voltage lines in the United States and Canada grouped according to trolley voltage is as follows:

System	Number of Installations	Miles — Route	Miles — Single Track	Rolling Stock — Cars	Rolling Stock — Locomotives
1,200 volts..	32	1,847	2,082	604	62
1,500 volts..	9	596	630	134	29
2,400 volts..	2	40	144	8	37
3,000 volts..	2	657	871	0	61
Total...	45	3,140	3,727	746	189

—*General Electric Review*, April, 1920.

Systems, Installations and Appliances

An Electric Water Heater.—E. F. RUSS.—Description of an electric water heater whose action is somewhat analogous to that of the induction furnace. Its construction is shown in the figure. The transformer core 5 passes through a hole in the water vessel 1. The transformer secondary consists of a thin copper or brass



INDUCTION HEATER

plate, bent into cylindrical shape, which is submerged in the water and thus will give over all its Joulean heat directly to the water to be heated. The thermal efficiency of this apparatus is claimed to be almost 100 per cent, giving an unusually quick-acting and economical water heater.—*Elektrotechnische Zeitschrift*, Jan. 22, 1920.

Importance of Control and Signaling Circuits in a Power Station.—PROBST.—The main power conductors in a power station are usually symmetrically and clearly arranged, so that a fault can be immediately located. But often the secondary wiring for meters, relays, regulators, etc., is bundled together in a haphazard way, making it hard to follow an individual conductor in case of trouble. The author emphasizes the importance of clearness and neatness in mounting all auxiliary conductors and shows on photographs and tracings some examples of the A. E. G. back-of-panel wiring system. —*Elektrotechnische Zeitschrift*, Jan. 29, 1920.

Electrophysics and Magnetism

Screening of Iron Parts from High-Frequency Magnetic Fields.—It is difficult to avoid iron parts in the construction of high-frequency apparatus. If subjected to rapidly alternating magnetic field, such iron masses will give rise to large energy losses due to hysteresis and eddy currents. This, however, may be avoided by screening caps of copper or zinc plate. Even a thin electrolytically applied covering often is quite sufficient in practice. Measurements on the screening effects of such metal covers were made by Preuner and Pungs (*Verhandlungen der deutschen physikalischen Gesellschaft*, Vol. 21, 1919, page 594). In this work the high-frequency resistance of a coil was measured by calorimetric methods. A core or plate of iron was placed in the field of the coil, and the difference in effective resistance was observed. While the apparent resistance of the coil was increased from two to seven times by the presence of the unscreened iron parts, the energy loss in the iron was almost entirely prevented by an electrolytic copper covering of 0.03–0.04 mm. (1.2–1.6 mils) thickness, or by a 0.1-mm. (4-mils) zinc layer. —Abstracted in *Elektrotechnische Zeitschrift*, Feb. 12, 1920.

Reactive Power and Magnetic Energy. — JOSEPH SLEPIAN.—The relation between reactive power and magnetic and electrostatic energies is stated and proved. Its utility is illustrated by deriving the connection between reactive power and the size of machines, between the magnetic energy of an alternating-current system and the field excitations of the synchronous machines therein, and by giving the physical significance of power factor under unbalanced conditions.—*Journal A. I. E. E.*, May, 1920.

Integration Method of Deriving Alternating-Current Resistance and Inductance of Conductors.—HARVEY L. CURTIS.—An integration method of deriving formulas for the alternating-current resistance and inductance of a straight cylindrical conductor by the use of both real and imaginary power series, and for a return circuit by the use of imaginary power series, together with an application to experimental results.—*Scientific Paper No. 374, U. S. Bureau of Standards*, April 7, 1920.

Electrochemistry and Batteries

The Fixation of Atmospheric Nitrogen by the Silent Electric Discharge Process—I.—C. F. HARDING and K. B. MCEACHRON.—The process of obtaining nitric acid from the air by means of the silent electric discharge has been under investigation during the course of several years at Purdue University. This paper is a preliminary report, although it is said considerable increase in yield has been obtained. The paper deals with the peculiarities of both electrical and chemical reactions, and there is considerable discussion of the apparatus and experimental methods so far used.—*Journal A. I. E. E.*, April, 1920.

The Electrodeposition of Metals.—W. E. HUGHES.—A discussion of the present status of electroplating in England with special reference to progress which has been made within the last few years. The writer deals with copper, silver, nickel, cobalt, zinc, iron, lead and other metals. He is of the opinion that the present rate of progress in the art of electroplating is not so rapid as it should be considering the possibilities in the art.—*Beama* (London), April, 1920.

Units, Measurements and Instruments

A New Form of Vibration Galvanometer.—P. G. AGNEW.—Vibration galvanometers are very useful in null measurements, but have not been much used in industrial laboratories on account of their being sensitive to external vibrations and requiring delicate adjustments. The present instrument, which has a sensitivity higher than other forms of moving-iron type but less than that of the most sensitive forms of the moving-coil type, has the advantages of sturdiness, quick responsiveness and freedom from the effects of external vibration. It consists essentially of a fine steel wire mounted on one pole of a permanent magnet and so arranged that the free end of the wire may vibrate between the poles of an electromagnet through which the current to be detected passes.—*Scientific Paper No. 370, U. S. Bureau of Standards*, March, 1920.

Telegraphy, Telephony and Signals

Guiding of Ships by Means of Submarine Cables.—R. H. MARRIOTT.—The author has devised a method of facilitating navigation of ships, particularly in fog, in dangerous passages and when entering harbor. A single-wire cable is laid along the route and anchored to the bottom. The far end is scraped free from insulation and thus acts as if it were grounded. The other end is connected to a buzzer or similar transmitter, sending out alternating-current impulses along the cable. A listening device, consisting of two large iron-cored coils (10 henries) and a pair of head-phones, is provided on board the ship. The search coils are suspended cross-ships on a framework, which can be rotated around a longitudinal axis. By tilting the coils till maximum sound is obtained in the telephone receivers the location of the cable can be easily and quickly determined. Several experiments which have been made with this system are described in the article, and a number of modifications are suggested.—*Revue Générale d'Electricité*, Jan. 24, 1920.

Miscellaneous

Electric Vaporization of Water.—If electric power is directly applied as Joulean heat, an efficiency of vaporization of more than 1.3 kg. (2.85 lb.) steam per kilowatt-hour can hardly be reached in practice. By the Wirth system of "autovaporization," however, a vaporization of 17 kg. (37.5 lb.) per kilowatt-hour may be obtained. The system has been further developed by Stodda in Zürich and is now employed by a number of Swiss soda works. The solution to be concentrated is first heated to the boiling point by steam passed through a coil of copper tubing. The vapor is pumped into a compressor, driven by an electric motor, and is compressed to about 1.2 atmospheres. The vapor then is passed through a second tube coil, submerged in the solution to be concentrated, and allowed to condense on the walls of the tube, thereby giving up its latent heat to the liquid, so that approximately the same amount of vapor is again formed.—*L'Industrie Electrique*, Jan. 25, 1920; also *Bulletin der Schweitzerischen Elektrotechnischen Verein*, December, 1919.

Manufacture of Varnished Cotton and Silk Cloth for Insulation Purposes.—A short discussion of how one British manufacturing concern produces insulating cloth of the required insulation value and with other necessary characteristics.—London *Electrician*, April 30, 1920.

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

NO LET-UP appears in general in the jobbing industry, although buying is lighter in some sections. Supply of goods regulates to a large extent the amount of buying today. Electrical materials have been coming in to jobbers in better quantity than a week ago, but they do not last long on the shelves. Back orders are being gradually cut down through recent receipt of shipments of pipe and flexible armored conductor, while in some quarters loom is in pretty good supply.

FANS are moving in good volume, although no long hot spell has been felt yet. Stocks are spotty and would stand a heavy drain with difficulty.

APRIL electrical exports fell off just over $1,000,000 from those of March, but the rate for the year, as shown by this first third, is over $86,000,000.

WAGE disagreements between the Amalgamated Association and the owners of union sheet and tin-plate mills loom up as a cloud on the electric sheet market. Some mills already have allotted sheet output for third quarter, but others are holding off.

MALLEABLE casting production is getting up nearly to 80 per cent capacity, an improvement over a few weeks ago. Molders, however, are still short in the industry.

FEW PRICE changes of interest are noted this week. Certain companies, however, are refusing to guarantee prices on any of their product.

A NEW ENGLAND Electrical Council has been formed to assist in coordinating the mutual interests of the manufacturer, jobber, contractor-dealer and central station. Representatives of each branch meet to hear the discussion of moot questions and recommend settlements.

ACUTE shortage of coal at public utility plants has caused an effort to be made to obtain from the Interstate Commerce Commission priority for coal consigned to utilities. Shutdown of some plants in New York City and elsewhere may be forced if conditions do not improve.

NEW ENGLAND industrial coal shipments went upon a preferential basis this week as the result of an order of the Interstate Commerce Commission granting priority for the transportation of bituminous coal to tidewater for transshipment by water to destinations within the United States.

AMONG bond issues announced are one of $5,000,000 for fifteen years at 7 per cent by the Cleveland Electric Illuminating Company and one of $4,000,000 for six years at 7½ per cent by the Shawinigan Water & Power Company.

INDORSEMENT of the organization plan of the Federated American Engineering Societies has been given by the Engineering Council.

A TOTAL membership of more than 300 of all classes in the North Central Electric Association, the first of the newly organized geographic divisions of the N. E. L. A. to hold a convention, was announced at its meeting in Minneapolis last week.

FIVE additional bodies, including the Electrical Manufacturers' Council and the National Electric Light Association, have been admitted to representation on the main committee of the American Engineering Standards Committee.

THE LICENSE fee of electrical contractors has been raised from $10 to $100 a year by the San Francisco Board of Supervisors, who defeated by a vote of three to one an effort to put it at $50.

A. MONRO GRIER was elected president of the Canadian Electrical Association at the annual convention held in Montreal, which was largely attended and characterized by optimism.

THE SPAN of 1,645 ft. between towers 235 ft. high which crosses the Connecticut River in the recently completed line from Hartford to Manchester, Conn., is the longest and highest in New England.

LOS ANGELES has awarded two contracts in connection with the further development of aqueduct power, one for electrical equipment to the General Electric Company and one for waterwheels to the S. Morgan Smith Company.

INCREASED rates for public utilities are being urged by the Illinois Manufacturers' Association.

A CONGRESSIONAL appropriation to investigate the water powers of Alaska is asked by the Alaska Advisory Committee in a communication to the Secretary of the Interior.

FURTHER standardization of apparatus is aimed at by the electrical apparatus committee of the N. E. L. A., which has held a meeting in Chicago to organize for work in a way that will harmonize with the new geographic divisions of the association.

ACTIVE construction has been started on the Big Creek No. 8 plant of the Southern California Edison Company. Transformers for 220,000 volts are being built.

A TEXTILE mill now being built at Danville, Va., will have an installation of 5,100 ½-hp. motors, a record number.

THE PLATFORM of the National Manufacturers' Association on industrial issues will be presented to the resolutions committee of the Democratic national convention when that body meets in San Francisco next week.

LATE on Friday afternoon of last week it was announced that President Wilson, acting on an opinion of the Attorney-General that such procedure would be constitutional, had signed the water-power bill on June 11, or ten days after its receipt by him. The bill is therefore now on the statute books, and already applications for licenses covering more than 500,000 hp. have been filed.

CO-OPERATION in formulating rules on inductive interference was furthered at a conference between representatives of the N. E. L. A., the Bureau of Standards and the American Telephone & Telegraph Company.

WIDE adoption of the standard cost-accounting system was called for by the National Electrical Credit Association at its convention in New York.

A BOND issue of $2,000,000 at 8 per cent has been made by the Idaho Power Company, an Electric Bond & Share property.

INCREASE in the electric rates of the Seattle (Wash.) municipal system has become law over the Mayor's veto. The Detroit Edison Company's new rates have gone into effect temporarily with the consent of the City Council.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Utilities May Get Coal Priority

INFORMATION relative to acute coal shortage at utility plants is being brought to the attention of the Interstate Commerce Commission in an effort to obtain priority of coal transportation for utilities. Not only is it impossible to store coal at this time, when coal is usually stored, but in a large number of instances utilities are running along with but a few days' supply. Unless the situation is remedied quickly, it seems certain that no small number of plants will be forced to curtail their supply of energy and in some instances to shut down entirely.

The National Committee on Gas and Electric Service, it is known, is making every effort to get a priority ruling from the Interstate Commerce Commission.

Representatives of New York City utilities met during the week to discuss the situation, and as a result two representatives of the Public Service Commission went to Washington to put the case before the Interstate Commerce Commission. That body has assured them that no public utility in New York City would have to shut down for lack of coal.

Another serious situation is the prevailing open market price for coal. J. W. Lieb, vice-president of the New York Edison Company, stated, on Tuesday, before the New York Public Service Commission, that while the utilities have contracts with different coal companies for bituminous coal, very few of them are getting deliveries up to the full contract requirements, and even where such deliveries are obtained the contracts do not cover more than 60 per cent of the coal requirements of the companies. The utilities, he stated, have been supplementing these contracts by going into the open market and purchasing coal at prices ranging from $13 to $16 a ton. Even at these high prices, Mr. Lieb said, the utilities find it difficult to get coal enough and have to bid against manufacturers and the general public to get any.

Institute Decides Against Parallel Sessions at Convention

THERE will be no parallel sessions, as was originally intended, at the thirty-sixth annual convention of the American Institute of Electrical Engineers, to be held from Tuesday to Friday next week at the Greenbrier Hotel, White Sulphur Springs, W. Va. All papers are to be presented in abstract, for which from five to fifteen minutes each will be all the time allowed. When the papers have all been presented in each session discussion will be invited.

Up to the time of going to press registrations had been received in New York from a little more than 200 members and guests. It was announced a few days ago that the Pennsylvania Railroad would put on a special car for the Institute convention on the 3:38 train out of New York Monday afternoon.

Water-Power Bill Finally Signed

WHEN Congress adjourned without the President having affixed his signature to the water-power bill it was taken for granted that the measure was lost. Under a ruling by the Attorney-General, however, his signature was affixed within the ten-day period and the bill becomes a law. It had been announced that soon after the close of Congress the Attorney-General rendered an opinion to the above effect, but it was not until late in the afternoon of June 18 that it was revealed that the President had affixed his signature to the water-power bill. The White House announcement reads as follows: "The President, having been advised by the Attorney-General in a formal opinion that the adjournment of Congress does not deprive him of the ten days allowed by the Constitution for the consideration of a measure, but only in case of disapproval of the opportunity to return the measure with his reasons to the House in which it was originated, has signed the following bills, each within the ten-day period, of course." The statement also points out that the bills not signed fail to become laws under the usual practice.

Applications for license covering more than 500,000 hp. have already been filed awaiting the organization of the Federal Power Commission. That so many applications should have been filed in so short a time after the signing of the bill is regarded as a very encouraging indication. Just when the commission will be organized is uncertain, but no action is likely to be taken until the Secretary of Agriculture returns to Washington after the San Francisco Democratic convention. The first move, however, must come from the President, who, according to the provisions of the act, must designate one of the three secretaries as the chairman of the Federal Power Commission. The secretaries in turn are expected to meet and designate the executive secretary, who in all probability will be the mainspring of the commission. It is regarded as obvious that the secretaries themselves will not devote a great deal of time to the work which will come before the commission.

The Comptroller of the Treasury has been acquainted informally with the question which has arisen as to the ability of the commission to employ personnel under the act. While the language of the act shows conclusively that it was the intent of Congress that the commission should have a technical and a clerical staff, no out-and-out provision is made for their employment. Owing to the importance of the matter, an early ruling

is expected. At worst, this oversight in drafting the law can be remedied early in December. The law clearly specifies, however, that the engineer assistant to the executive secretary may be designated. Owing to the multitudinous duties which devolve immediately upon the commission, it is anticipated that the engineer officer will be designated at the earliest possible moment.

The act provides that a report must be made on the Great Falls project, on the Potomac River, by Jan. 1. For that reason the examination must be begun at a very early date.

Without question, the most serious problem facing the commission at the start of its work will be the difficulty of securing competent men. The whole foundation of the act is the matter of "net investment." This must be ascertained by an accurate system of accounting which will not run cross-wise with the accounting systems of the states. Necessarily, the man in charge of this work must be one who is familiar with state accounting methods, and, owing to the importance of this portion of the work as well as all matters pertaining to valuation, it is regarded as poor economy to attempt such work with other than comparatively high-salaried men.

Under the terms of the act, public notice must be given eight weeks before the commission can act on any application. It is probable that these notices will be made public through the field offices of the three departments concerned.

Apparently the only ones who are questioning the legality of the water-power act are those who believe that they will be injured by it. Attorneys for some of the larger investment bankers are understood to have reported favorably on its legality. From such information as has reached Washington, this phase of the matter will impede in no way the flow of capital into water-power investments.

The consensus of opinion among legal authorities in Washington apparently is that the Attorney-General is correct in his interpretation of the Constitution as to the President's authority to sign bills within the ten-day limit even after the adjournment of Congress. It is pointed out that the practice which has been observed heretofore deprives the President of his constitutional right to review legislation before affixing his signature. The practice heretofore has been such as to necessitate the President's signing "on the dotted line" any legislation which was ground out at the close of Congress without careful inspection, or else automatically vetoing it by withholding his signature.

North Central Utility Men See Need for Education of Public

PUBLIC utility men of Minnesota and North and South Dakota, meeting at the first annual convention of the North Central Electric Association, in the Hotel Radisson at Minneapolis, June 15-17, emphasized the need for education of the public to the true nature of the problems of the electric light and power industry. Insistence on the necessity of such education and on the importance of bringing the facts in a straightforward and vigorous manner before the communities served ran through nearly all the addresses.

That the fuel situation is serious in the Northwest was indicated by President Crocker, who, as reported last week, stated that deliveries since the opening of navigation on the Great Lakes have not even supplied current requirements, though demand is lightest at this season. The shortage and high cost of coal have brought to the front the necessity of developing the lignite coal supplies of Minnesota and the Dakotas.

R. F. Pack of Minneapolis pointed out the difficulties of utilities because of the lack of understanding of their problems on the part of the public and urged the importance of education and of frank, honest dealing.

An analysis of the factors affecting the price of public utility financing from the bankers' point of view, reprinted in part on pages 14 and 18, was made by Henry D. Thrall, vice-president of the Minnesota Loan and Trust Company.

RURAL ELECTRIC LINES

Rates for rural service in which a rural charge covering the amount by which the fixed charges, energy losses and operating expenses incident to rural service exceed the corresponding items for city service is a feature touched on by F. R. Winders of the Railroad Commission of Wisconsin in a discussion of rules governing rural service recently established in Wisconsin. The rural charge plus the regular urban rates constitutes the rate for service. In the discussion Lee Boyer of Deadwood, S. D., brought out the fact that practice tends toward the advancing of the total cost of construction of rural lines by the farmers and the use of a rate with a fixed charge rather than a minimum charge. The problem of handling the prorating of costs for consumers coming on after lines are built is a puzzling one, said R. M. Howard of Winona, Minn., who pointed out that from the accounting standpoint a limit must be reached and accounts closed. That revenues are not sufficient to justify service without advance of construction costs by the farmer and that contracts must be made with a definite limit and a simple method of refunding to those who financed the construction originally when new consumers are connected was contended by H. H. Henley of Minneapolis.

A paper on "Present-Day Conditions and Tendencies in the Development of Domestic Electric Cooking," by H. A. Dahl and Miss Bernice Bell of the electric cooking bureau of the Minneapolis General Electric Company, produced a sharp discussion Friday afternoon on the situation created by the swamping of the manufacturers with new business. That many central stations are receiving ranges improperly assembled and with defects of workmanship was strongly asserted. The extreme difficulty caused by the long delay in delivery of repair parts was shown, many central stations finding it necessary to manufacture their own repair elements.

At the business session Thursday afternoon a committee was appointed to keep in touch with the fuel situation and devise ways and means of meeting problems as they arise, as was also a committee to study the utilization of lignite coal and freight problems.

The officers elected were: President, T. D. Crocker, Minneapolis, Minn.; vice-president, O. A. Rofelty, Sioux Falls, S. D.; treasurer, F. C. Hoffman, St. Paul, Minn. The executive committee will comprise W. N. Ryerson, Duluth, Minn.; W. C. Blanchard, Aberdeen, S. D., and M. L. Hibbard, Fargo, N. D. Increasing of the executive committee membership to four, to allow the appointment of a representative of the municipal plants which have heretofore participated actively in association affairs, was recommended.

The convention is the first held by any of the geographic divisions of the N. E. L. A.

Rural Service and Inductive Interference Discussed by Iowa N. E. L. A.

THAT the financing of rural lines and the method of establishing rates for rural service are two of the pressing questions before Iowa light and power utilities was the consensus of opinion at the opening session of the nineteenth annual convention of the Iowa Section of the National Electric Light Association, held at Colfax, Iowa, Wednesday. The forenoon of that day was devoted to organization and appointment of committees, and nearly the entire afternoon was taken up with a lively discussion of the report of the farm-line committee. The tendency is toward the financing of lines by the farmers.

The report of the inductive interference committee was presented and discussed, attention being called to the necessity of close co-operation with the parent body. The sessions continued through Thursday and Friday.

Sectional Rules on Inductive Interference Receive National Attention

A GREAT advance in co-operation between the National Electric Light Association, the Bureau of Standards and the American Telephone & Telegraph Company was marked by a meeting Tuesday in the N. E. L. A. rooms on inductive interference. The meeting was attended by Dr. E. B. Rosa and Dr. M. G. Lloyd of the Bureau of Standards; Thomas Sproule, W. K. Vanderpool, A. E. Silver, Mr. Ware and W. J. Canada, representing the N. E. L. A., and H. S. Warren, Kenneth Wilkinson and E. B. Craft, representing the A. T. & T.

The meeting was called to discuss the situation created by the preparation in California by a committee of public utility representatives of a set of overhead-line rules which differ in some important respects from the National Electrical Safety Code requirements. Those present also came together to see what it might be possible to do with the code itself or in the way of securing increased co-operation in order to avoid any necessity for sectional rules covering the same general line. The subject will be continued further.

Engineering Council Indorses Federation

THE Engineering Council, at its regular meeting on June 17, indorsed the organization plan of the Federated American Engineering Societies. The executive committee of the council was authorized "to proffer and perform on the part of the council such assistance as may be practicable in completing the work of the organizing conference and of the joint conference committee of the founder societies in establishing the American Engineering Council" and also "to deal with any question of co-operation with the joint conference committee of the founder societies, relating to the permanent organization of the Federated American Engineering Societies, which may come up during the summer."

Finally, the secretary of council, Alfred D. Flynn, was instructed "to invite to future meetings of the Engineering Council delegates of the societies participating in the organizing conference in Washington, June 3 and 4, and editors of technical journals who may be interested."

Nine Million Dollars Issued by Two Utilities for New Construction

ANNOUNCEMENT was made this week of the issue of $5,000,000 fifteen-year 7 per cent first mortgage collateral bonds at 95½ by the Cleveland (Ohio) Electric Illuminating Company and $4,000,000 six-year 7.5 per cent secured convertible gold notes at 98.65 by the Shawinigan (Quebec) Water & Power Company.

The sale of the securities of the Cleveland Electric Illuminating Company, it is stated by Vice-president and General Manager Robert Lindsay, will provide funds for plant extensions. These additions include the installation of 25,000 kw. of generating capacity and extensions to the distributing system necessary to meet the increased demands, chiefly from manufacturing plants.

Proceeds of the notes of the Shawinigan Water & Power Company will be sufficient to pay all present floating debt, according to J. E. Aldred, president of the company, and also provide for construction work scheduled for 1920, including the construction of an additional 85-mile (136-km.) transmission line to Montreal and the installation of 50,000 additional horsepower in the hydro-electric plant at Shawinigan Falls.

Standard Service Voltage to Be Pushed by Apparatus Committee

CLOSE after the adjournment of the national convention at Pasadena the electrical apparatus committee of the National Electric Light Association was called together in Chicago by Chairman R. F. Schuchardt for the purpose of so organizing the committee and its work that it would tie in with the geographic divisions which have been made a part of the national organization. It was also desired to continue the work of the committee from last year without a break. The principal work planned for the coming year, in addition to continuing the regular program, is to aid manufacturers and central stations to a further standardization of apparatus in order to reduce its cost.

Work on transformer standardization is being continued, and by a letter vote of twenty-seven to one the committee recommended the substitution of 1.5-kva. single-phase transformers of 4,600 volts or less in place of the 1-kva. and 2-kva. sizes now in general use.

Work will be begun by the committee this year looking to the standardization of service voltage of central stations. The preparation of an operating code for major electrical apparatus will also be attempted.

The manufacturers will be urged to standardize further on the oil used in transformers, oil switches and lightning arresters.

The subject chairmen of the electrical apparatus committee are as follows: Generating stations, H. C. Albrecht, Philadelphia Electric Company; substations, H. W. Eales, Union Electric Light & Power Company, St. Louis; oil switches, accessories and switchboard equipment, A. H. Lawton, Consumers Power Company, Jackson, Mich.; transformers, G. L. Knight, Brooklyn (N.Y.) Edison Company; motor rules, H. L. Wallau, Cleveland (Ohio) Electric Illuminating Company; miscellaneous apparatus, A. S. MacDowell, Rochester (N.Y.) Gas & Electric Corporation; standardization of service voltages, M. O. Troy, General Electric Company, Pittsfield, Mass., and A. W. Copley, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Idaho Power $2,000,000 Bond Issue Bears 8 Per Cent Interest

TO INCREASE plant capacity and extend transmission system, the Idaho Power Company, one of the Electric Bond & Share properties, has just issued at par $2,000,000 of first lien and general mortgage ten-year 8 per cent gold bonds. This is the first electric light bond issue of any considerable size in which the prevailing rates for money have apparently been recognized to the extent of placing an interest rate for the issue sufficient to warrant its sale at par value. When this was brought to the attention of the officials of the Electric Bond & Share Company no statement could be elicited, for the reason, it was said, that the company did not care to go on record as saying that it was prepared to pay any stated interest rate for money.

Big Creek No. 8 to Use Transformers Built for 220,000 Volts

OWING to the insistent demand for more power, there has been a change in the plans of the Southern California Edison Company for the development of Big Creek. According to the new plans, Big Creek No. 8 will be the next plant to be put into operation, and active construction thereon has been started. It will be situated just below Big Creek No. 2 and will use the waters from Huntington Lake and Shaver Lake after they have passed through plant No. 2. After the completion of the Mammoth Pool tunnel this plant will also utilize the waters of the San Joaquin River.

The first unit to be installed will be a 30,000-hp. Francis turbine driving a 22,500-kw. generator, the turbine operating under a head of 700 ft. (210 m.). The generating voltage will be 11,000, which will be raised to 150,000 volts for transmission to Los Angeles. An interesting feature of the installation will be the construction of transformers which are being built for 220,000 volts. The plans are eventually to raise the entire Big Creek system to this higher voltage, and at that time this plant can be brought into service by simply changing the taps on the transformers.

Preliminary work has been done on the tunnel, and a large crew is to be put to work at once, as it is desired to have the new unit in operation for the summer load of 1921. This plant, with the additional machine now being installed in plant No. 2 and the new plant on Kern River, nearing completion, will give the Southern California Edison Company 75,000 kw. additional capacity.

Depreciation Charges as They Affect Freight Rates Paid by Utilities

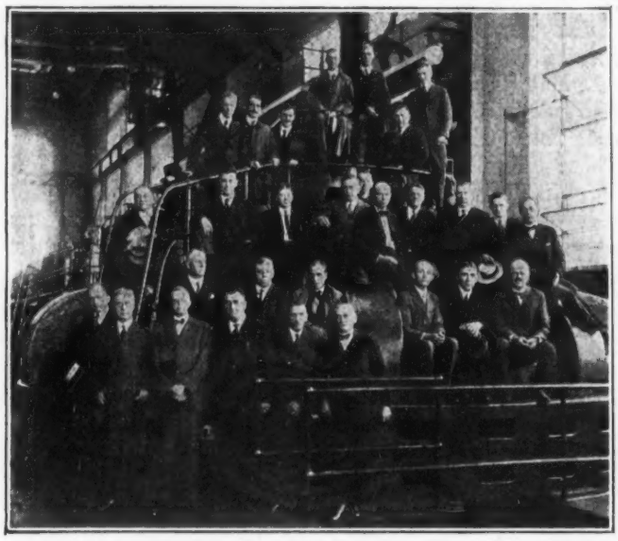
AN INTERESTING discussion of the effect on freight rates of depreciation charges in excess of actual and necessary disbursements for maintenance of efficient operation is contained in a petition recently filed by the Consolidated Gas Company of New York with the Interstate Commerce Commission for leave to intervene on behalf of itself and its affiliated companies "in the matter of the application of carriers in official Southern and Western classification territories for authority to increase rates." Alluding to the total output of gas and electrical energy by it and its subsidiary companies and to its 1,409,774 customers, the petition of the Consolidated Gas Company points out that all the coal and much of the other materials used in the production of its commodities and the making of extensions and repairs are transported by freight, the company thus becoming one of the largest patrons of railroad transportation in the United States. Thus the petitioner and its consumers have a direct interest in the keeping of interstate freight rates on all such commodities at a point no greater "than is from time to time reasonably necessary to pay the actual cost of the rendering of adequate and efficient service by such common carriers and the maintenance and upkeep of their property in first-class operating condition and to pay a reasonable return upon their invested capital."

The petition then enters into an argument against depreciation charges being based on assumed life of equipment, holding that such charges should be restricted to those necessary to equalize from year to year the charges for extraordinary repairs and for renewals and replacements that occur irregularly.

In concluding its plea the Consolidated Gas Company asks:

That the commission will find that for Class I carriers there are no "classes of property for which depreciation charges may properly be included under operating expenses," and that it will require that the maintenance charges for any calendar year, including charges for renewals and replacements, be stated on the basis of expenses actually incurred during that year, to the end that freight rates be placed at a level which will be fair both to carriers and to shippers, and that they be not made unduly high in order to provide for estimated charges not based on actual facts.

New England Load Dispatchers Meet



A TWO-DAY meeting was held last week, June 16 and 17, by the New England Load Dispatcher's Club, the pioneer organization of its kind. On the first day the club met at Greenfield, Mass., where Howard M. Turner, consulting engineer, Boston, spoke on "Hydro-Electric Development." On the seventeenth plants of the Turners Falls Power & Electric Company and the New England Power Company were visited, with camp luncheon at Vernon, Vt. The club was founded to promote personal acquaintance and technical co-operation among the men in immediate charge of plant and system administration in New England interconnected utilities, and it has already achieved marked progress in the efficient conduct of interconnected service. The members of the club were photographed at the Cabot station of the Turners Falls company, the largest hydro-electric plant in New England.

Active Work Planned by Canadian Electrical Association

THE Canadian Electrical Association held its thirteenth annual convention, June 16, 17 and 18, at Montreal, Que. In attendance the meetings were larger than any held within the past few years, and altogether the convention marked a new era in Canadian electrical affairs. A new constitution and bylaws in conformity with the revised constitution and bylaws of the National Electric Light Association were adopted, and it was decided to remove the headquarters from Toronto to Montreal and to engage in more energetic work under the direction of a paid secretary. Martin J. Insull of Chicago, president of the National Electric Light Association, was in attendance and in a well received address outlined the new organization of the national association and the plans for the coming year.

At the executive session held on June 18 the following officers were elected: President, A. Monro Grier, K.C., Canadian Niagara Power Company, Niagara Falls, Ont.; first vice-president, P. T. Davies, Southern Canada Power Company, Montreal; second vice-president, A. P. Doddridge, Quebec Railway, Light, Heat & Power Company; third vice-president, L. W. Pratt, Hamilton (Ont.) Cataract Light & Traction Company; secretary-treasurer, Eugene Vinet, Shawinigan Water & Power Company, Montreal. Members of the executive committee were elected as follows: One-year—A. A. Dion, Ottawa (Ont.) Electric Company; J. B. Woodyatt, Southern Canada Power Company, Montreal; F. F. Kaelin, Shawinigan Water & Power Company, Montreal; A. V. Gale, Hull (Que.) Electric Company. Two-year—R. J. Beaumont, Shawinigan Water & Power Company, Montreal; J. S. Norris, Montreal Light, Heat & Power Company; D. H. McDougall, Toronto Power Company; Charles Barnes, Toronto & Niagara Power Company. Manufacturers' representatives, two-year — Canadian Westinghouse Company, Canadian Edison Appliance Company or representatives of other Canadian General Electric subsidiary; one-year, Northern Electric Company and Lincoln Meter Company.

COMMITTEE REPORTS

The first day's session was given over to reports of committees, most of which were résumés of N. E. L. A. reports. The program of reports was as follows: Meters, E. J. Turley, Montreal Light, Heat & Power Company; prime movers, S. Svenningson, Shawinigan Water & Power Company, Montreal; electrical apparatus, J. F. Neild, Toronto & Niagara Power Company; overhead lines, R. J. Beaumont, Shawinigan Water & Power Company; commercial sales and rates, P. T. Davies, Southern Canada Power Company Montreal; accounting, C. Johnstone, Southern Canada Power Company; accident prevention, Wills Maclachlan, Electrical Employers' Association of Ontario. In addition, reports were presented by representatives of N. E. L. A. committees and by representatives of the Canadian Engineering Standards Association.

In Canada all watt-hour meters are sealed by the government for a period of five years, after which time they must be retested and resealed. The committee on meters suggested, in view of the very small percentage of meters found to fall outside the government requirements, that this sealed period be extended to eight years. It was also recommended that meters be sealed and tested *in situ* so as to avoid damage to jewels caused by the removal and shipment of the meter.

The report of the committee on prime movers covered steam and hydro-electric as well as oil-engine practice, but considering that the electric power developments in Canada are chiefly hydro-electric, from 85 to 90 per cent of the total energy generated coming from such systems, chief attention was given to that subject. The committee noted the tendency toward vertical units and the development of new high-speed runners for plants of low head. In Canada wheels have been constructed with the speed rings made so that hot water can be circulated therein and then through the guide vanes in order to obviate fragile ice troubles. Such a system has long been recommended by John Murphy of Ottawa.

The general opinion was that ice troubles can be prevented to a large extent by (1) drowning out rapids above the power site, (2) locating the development so that the prevailing winds will tend to blow the ice away from the forebay, (3) heating the racks and runners slightly above the temperature of the surrounding water, (4) keeping a careful log of weather and ice conditions and noting the relation of one to the other.

In the discussion it was brought out that many of the large hydro-electric companies possessing big wheels have made a practice during the winter of pulling the racks and letting the small pieces of ice pass through the wheels. It was pointed out, however, that this could not be recommended for the smaller companies.

The committee on electrical apparatus showed that power plants are at the present time suffering more or less from results of war-time economy and in some cases are experiencing difficulty due to delayed reconstruction work, which work must now be undertaken in the face of higher costs. It was recommended that greater use be made of standard apparatus and that service voltages be standardized to bring down costs.

In its report on overhead lines the committee called attention to the standardization work of the Shawinigan Water & Power Company and associated companies on overhead lines. The companies have standardized on 2,300-volt distribution and have printed and distributed handbooks among their engineers and operating men covering standards of low-voltage line construction in cities and towns and also covering transformer standardization. This work has had a notable effect on the amount of material carried in stock. For instance, four-pin cross-arms, heretofore carried in twelve different sizes, are now stocked in only one size. Commensurate reductions in sizes of bolts, braces and other material have also been effected.

POWER PRICES

R. J. Beaumont, chairman of the committee, also presented a short dissertation on power prices, past and present. He showed that interest on investment has increased one and one-half times, cost of material three times, as compared with the costs five or six years ago, so that the total overhead burden is four and one-half times, or 27 per cent, as compared with 6 per cent. As a result more careful and closer measurement of the maximum demand is to be expected, and hydro-electric energy will hereafter be sold on a straight unit basis rather than on a charge of so many kilowatts per month or year.

The report of the committee on commercial sales

and rates was devoted to the following subjects: Electric ranges, water heaters, ovens, etc., sales of electrical appliances, brass furnaces, off-peak loads, seasonable loads and surplus power contracts, and power factor. The committee is of the opinion that the time is not far distant when kilovolt-amperes and kva. hours will be the basis of billing and 100 per cent power factor will be required.

The sub-committee on lamps of the Canadian Engineering Standards Association is composed of members representing the manufacturers, public utilities, the Department of Trade and Commerce of Canada and the Canadian Electrical Association, under the chairmanship of John Murphy, chief electrical engineer of the Department of Railways and Canals. Circular 13 of the United States Bureau of Standards has been taken as a basis for discussion in the formulation of the proposed incandescent-lamp standardization for Canada, as it is considered to be the best and most comprehensive document to work on.

On Wednesday evening a formal dinner was held in the grill of the Ritz-Carlton. Addresses were made by R. A. Ross on behalf of the city of Montreal, A. Monro Grier for the Canadian Electrical Association and Martin J. Insull for the National Electric Light Association.

Two papers were presented June 17, one by Paul M. Lincoln on "Metering the Customers' Load" and the other by J. R. Colville of the National Lamp Works, Cleveland, on "The New Viewpoint on Modern Lighting."

National Manufacturers Now Present Views to Democrats

THE nine-plank platform embodying the views of the National Association of Manufacturers on the position that should be taken on industrial questions by the political parties is to be presented to the resolutions committee of the Democratic National Convention as soon as that committee is organized in San Francisco next week. Sixteen prominent Pacific Coast manufacturers form a committee having this matter in charge.

A summary of the manufacturers' platform, which was also presented to the Republican National Convention at Chicago, but not incorporated by that body in its own platform, was printed by the ELECTRICAL WORLD for June 12, page 1385.

Seattle Municipal Rates Increased from 9 to 25 Per Cent

THE Seattle City Council on Monday passed the ordinance providing for increased rates on the municipal system over the veto of Mayor Hugh M. Caldwell. The new rates are effective July 21. Mayor Caldwell, as stated in the ELECTRICAL WORLD for last week, vetoed the measure after it had been passed by the Council, stating that an interview with Superintendent of Lighting J. D. Ross had convinced him that there was no necessity for an increase at this time.

The ordinance provides that commercial houses will pay 1 cent more for energy under the proposed schedule, the old rate being 4½ cents for the first 100 hours and the new rate 5½ cents. Energy in excess of 100 hours will cost commercial houses 1½ cents instead of the present charge of 1½ cents. The increase in the electric cooking rate is from 5½ cents to 6 cents per month for the first 45 kw.-hr. and from 2 cents to 2½ cents for the secondary rate.

Manufacturing concerns will pay 4 cents for the first 100 hours for power purposes and 1 cent for power in excess of that amount.

According to estimates of members of the City Council, the increased rates, which are from 9 to 25 per cent higher, will result in an additional revenue of $281,639.66.

Business Men Urge Financial Relief for Utilities

EIGHT organizations, representing 16,250 business men, have appealed to the Illinois Public Utilities Commission in a joint memorial urging that action be taken by the regulatory body to give immediate relief to the utilities of the state. The memorial, which was presented in formal session before the commission by a joint committee, is signed by the presidents or other officials of the Chicago Association of Commerce, Illinois Manufacturers' Association, Chicago Credit Men's Association, Citizens' Association of Chicago, Commercial Club of Chicago, Industrial Club of Chicago, Traffic Club of Chicago and Union League Club of Chicago.

It is pointed out that, while service generally now is unsatisfactory, it will become worse unless immediate financial relief is afforded either by higher rates or in some other way. It is furthermore stated that the present condition of the financial market will automatically act to prevent any extensions other than those absolutely necessary.

Without going into the merits of any particular case, the memorial earnestly urges the necessity of immediate relief because unless prompt action is taken even the present unsatisfactory public service cannot be maintained. In conclusion the memorial suggests temporary relief as follows:

"We respectfully suggest that in all cases where it is impossible for the commission to give the case presented such an exhaustive consideration as will enable the commission to determine and prescribe a permanent rate or plan respecting the utility under consideration tentative orders be entered covering experimental or temporary periods until such time as the experience of the commission or further investigation and deliberation will enable your honorable body to do complete and full justice in the premises."

S. L. Nicholson Re-elected Chairman Manufacturers' Council

AT A MEETING of the Electrical Manufacturers' Council on June 18 the following officers were elected for the ensuing year: Chairman, S. L. Nicholson, Westinghouse Electric & Manufacturing Company; vice-chairman, Le Roy Clark, Safety Insulated Wire & Cable Company; treasurer, E. B. Hatch, Johns-Pratt Company. Frederic Nicholas was reappointed executive secretary. The office of vice-chairman is a new one, authorized by a change in the constitution approved at the meeting on June 18. It was created because of the expansion in the work of the council in connection with the establishment of headquarters in New York. Mr. Nicholson and Mr. Hatch were re-elected to the same positions which they had held.

City Council Consents to Detroit Edison Increase

THE Detroit City Council has consented to the putting of the new rates of the Detroit Edison Company into effect temporarily on July 1. The action was recommended by Henry Steffens, Jr., controller, who will proceed to make a complete examination to see if the rates are justified. His preliminary examination has revealed no reason why the temporary approval should not be granted. Alex Dow, president of the Detroit Edison Company, told the Council the new rates would net $1,599,500 a year additional revenue.

American Engineering Standards Committee Enlarged

FIVE additional bodies have been admitted to representation on the main committee of the American Engineering Standards Committee. They are the Electrical Manufacturers' Council (comprising the Electric Power Club, the Associated Manufacturers of Electrical Supplies and the Electrical Manufacturers' Club); the fire protection group (composed of the National Fire Protection Association, the National Board of Fire Underwriters, the Associated Factory Mutual Fire Insurance Companies and the Underwriters' Laboratories); the National Electric Light Association, the National Safety Council and the Society of Automotive Engineers. These, with the five engineering societies that founded the committee (American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers and American Society for Testing Materials) and the three government departments added later (Commerce, Navy and War), make a total of thirteen organizations having representation on the main committee.

It is the policy of the committee to encourage representation by groups in such a manner that a group shall represent substantially the entire field of a particular industry in order that it may "be of national scope." In the opinion of the committee the group plan makes for efficiency in standardization work.

The Electrical Manufacturers' Council has designated LeRoy Clark, A. H. Moore and C. E. Skinner as its representatives on the committee.

Elihu Thomson Lays Down Principles for Inventors

ONE of the most inspiring things about an engineering career is the continual progress in understandable science, declared Dr. Elihu Thomson, acting president of the Massachusetts Institute of Technology, in an address week before last to those graduating. Calling attention to the new vistas, theoretical and practical, which are constantly opening before the progressive student, Professor Thomson said: "Note, for example, the seemingly unlimited possibilities in wireless transmission following the creation of thermionic amplifiers, the thermionics engineering of the future. It may soon be that a station in Paris, London or Washington will talk to the whole world, and that an instrument small enough to be installed in one's study may permit us to hear what is said.

"Some untrained and uninformed minds possess the quality of originality in a considerable degree," said Dr. Thomson. "Unless tempered by sound judgment, sense of proportion and adequate knowledge, the results may be erratic. Invention in the engineering sense involves originality, but not that alone, if the results are to be of value. There is imagination more or less fertile, but with it a knowledge of what has been done before, carried perhaps by the memory, together with a sense of the present or prospective needs in art or industry.

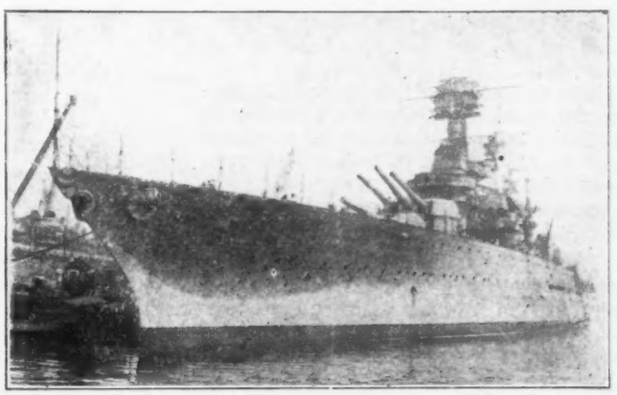
"Necessity is not always the mother of invention. It may be prevision. As to value in invention, it is often said, and said truly, that ideas are cheap, but those which are really novel, and which will bear the cost of developing them so as to return value for the effort involved, are rare. Not all apparently good ideas, even if new, are capable of commercial development.

"Shall an invention be patented or donated to the public freely? I have known some well-meaning scientific men," Professor Thomson said, "to look askance at the patenting of inventions, as if it were a rather selfish and ungracious act, essentially unworthy. The answer is very simple. Publish an invention freely, and it will almost surely die from lack of interest in its development. It will not be developed, and the world will not be benefited. Patent it, and if valuable, it will be taken up and developed into a business."

Textile Mill Will Require 5,100 Half Horsepower Motors

A NEW record in number of individual-drive motors will be established when the mill of the Riverside and Dan River Power Company at Danville, Va., is completed. The previous record in a textile mill was 3,000 motors, while the new plant will require 5,100 motors. All of these motors will be standardized at ½ hp. and will be of the same type and make. Lockwood, Green & Company of Boston are the engineers, while the Walker Electric Company of Atlanta is handling the electrical installation. The plant should be in operation about Jan. 1, 1921.

The U. S. S. Tennessee in Commission



THE electrically propelled United States battleship Tennessee, which went into commission on June 3, is the most powerful fighting vessel in the world today. She is 625 ft. long, has a beam of 98 ft. and displaces 32,500 tons. Her main battery consists of twelve 14-in. guns, and she is protected by a belt of armor 14 in. thick. Her main engines consist of two Westinghouse turbine-generators, rated at 15,000 kva. each, and each of the four propellers is driven by an 8,000-hp. Westinghouse motor. Her maximum speed with full power is 21 knots.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

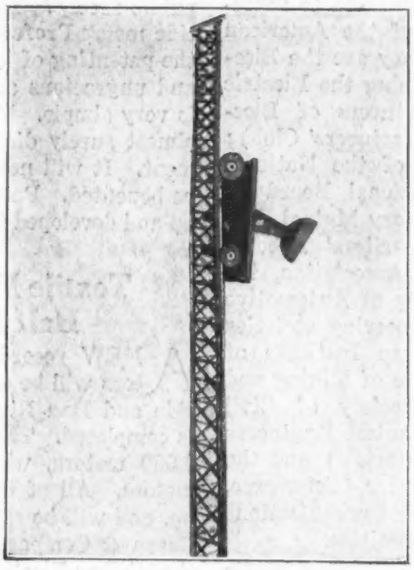
Seattle Municipal Plant Report.—According to the report made by the electrical department of the city of Seattle, a net gain was made by the department in the year 1919 of $473,955.53, but this was absorbed by construction work that was undertaken by the department at a cost of $1,000,000, leaving a deficit at the present time of approximately $580,000. The figures shown by the department's report were: Operating revenues, $2,087,563.45; operating expenses, $1,403,940.27.

Power Company Asks for 100 per Cent Increase in Rates.—A hearing in the application of the Hartford Power Company of Clay County for increased rates was held this week by the West Virginia Public Service Commission. The company, saying that it has gone into the hands of a receiver because of insufficient earnings, asked for an increase of 100 per cent in its primary charges and 125 per cent in the secondary charge. On night service it wants an increase of 25 per cent in addition to the 100 per cent in the primary charge.

Increased Cost of Water Power.—The Missouri Public Service Commission has granted the Union Electric Light & Power Company of St. Louis permission to pay the Mississippi River Power Company $277,777 more per year than has been paid for the 49,236 kw. furnished to the St. Louis company from the hydro-electric development at Keokuk, Iowa. The new rate is made retroactive to Aug. 1, 1919, and is effective for ten years from that date. The increase, which is from $16.34 to $20.55 per horsepower-year, is less than one-third as much as the contract between the two companies calls for based on the increased price of coal, but it is figured to give a fair return on the Mississippi River Power Company's investment.

Music by Wireless.—As an incidental result of research work on radio-telephony at the Bureau of Standards, it has been shown that music can be transmitted by radio without loss of quality. The possibilities in this direction are held to be great and very interesting. A concert, for instance, given in one place may be made available to those living at a distance. Experimental "concerts" are at present being sent out on Friday evening from 8:30 to 11 by the radio laboratory of the Bureau of Standards, using a wave length of 500 m. One way of transmitting music has been to place a phonograph so that the sound from it will pass into the radio transmitter. The Bureau of Standards has made an improvement upon this method. This consists in substituting the carbon microphone, which is the mouthpiece of an ordinary telephone, for the vibrating diaphragm ordinarily used on the phonograph. As a result, the phonograph sound record produces direct variations of electric current.

An Aërial Collision.—The accompanying illustration, reproduced from the London *Electrician*, shows the result of an extraordinary accident which took place during the war when a British hydroplane collided with a 440-ft. wooden-lattice tower, one of three forming part of the radio-telegraphic installation on Horsea Island, Portsmouth.



The collision took place at a height of 356 ft. and the hydroplane became firmly wedged in the mast. A sailor attached to the station rescued the pilot.

More Light on the Laying Hen.—Stimulating egg production by electricity is an old device the success of which is so well established that it is said a great many poultry dealers in all sections of the country are getting an increased output of from 35 to 70 per cent above former figures by lighting their chicken pens in the early morning hours before daylight. The general practice is said to be to light up the pens at 3:30 a.m. from Oct. 15 to Feb. 15, then at 4 a.m. for another month, after which the artificial lighting is discontinued. The average amount of lighting is put at 1 watt for every 50 sq.ft. of floor surface. That there is such a thing as overworking a willing hen, with eventual decrease of product, is, however, generally recognized by breeders. A writer in *Edison Current Topics*, the house organ of the Southern California Edison Company, points out that from the electric company's standpoint the benefits are great. The average lighting bill has been increased from $1.25 to $8 or more a month, the hours of burning are off-peak, and the service is supplied on the lighting rates.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Electric Club of Chicago.—The Tuesday luncheons of this club have been discontinued for the summer. They will be resumed in September.

A. I. and S. E. E., Pittsburgh Section.—The meeting of this section of the Iron and Steel engineers which was announced for June 12 was postponed. R. H. Keil, power engineer Jones & Laughlin Steel Company, Pittsburgh, will present his paper on "Current Limit Reactance" at the annual convention of the association in New York.

Meetings Next Week.—The Associated Manufacturers of Electrical Supplies, who convene today at New London, Conn., will hold their section meetings on Monday, Tuesday and Wednesday of next week. The annual convention of the American Institute of Electrical Engineers meets at White Sulphur Springs, W. Va., on Tuesday, Wednesday, Thursday and Friday. The Society for the Promotion of Engineering Education holds its annual meeting at Ann Arbor, Mich., on the same days.

Reorganization of Milwaukee Section, A. I. E. E.—The local dues of $1 per year, which have been collected by the Milwaukee Section of the A. I. E. E. before enrolling national members as members of the local section, will not be required after July of this year. The Milwaukee Section has been working under a plan whereby it paid the Milwaukee Engineers' Society $3 per section member per year and joined with the local engineering society in all of its technical meetings. The difference between the $1 paid by A. I. E. E. members to the section and the $3 paid by the section to the Milwaukee Engineers' Society has been made up by the annual appropriation received from A. I. E. E. headquarters. Under the new plan, which goes into effect next fall, the Milwaukee Engineers' Society will send announcements of all meetings to the entire American Institute section as heretofore and the A. I. E. E. members will continue to be invited to all the Milwaukee Engineers' Society meetings. However, the local section of the American Institute will not belong to the engineers' society in a body but the members will be invited to join the combined engineering body in Milwaukee individually at a cost of $5 per year. The initiation fee will be waived. The local members of the American Institute will no longer be asked to contribute to the Milwaukee Section, because the allowance from Institute headquarters will hereafter be used to cover all section expenses.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Reduced Rates to Allied Company Held to Be Discriminatory.—The Pennsylvania Public Service Commission has refused to approve a new schedule of rates adopted by the Home Electric Light & Steam Heating Company, operating in Tyrone, which while making substantial increases to other customers permitted the Altoona & Logan Valley Railway Company, its lessee, to receive energy at the former rates. It was contended that the railway company could procure its energy from another electric company at the old rate, but the commission held that this alleged fact did not prevent the Home company's rates from being discriminatory and ordered them revised to apply equally to all customers.

Compulsory Extension of Service.—An electric utility chartered to do business within the state without limit as to particular localities and possessing franchise rights to occupy public highways may be compelled, according to an opinion of the Missouri Public Service Commission in a complaint against the Ozark Power & Water Company, to serve a locality with which it is in proximity where such an extension of service constitutes a reasonable improvement. In accordance with this principle the commission found that where a sufficient number of consumers agree to take service at rates yielding operating expenses, depreciation and return upon investment—in the case in question 15 cents a kilowatt-hour with a minimum charge of $1.50 monthly—the company must render the service irrespective of the desires of its officers.

Average Return as Factor in Rate Fixing.—In passing upon the application of the St. Joseph Railway, Light, Heat & Power Company for increased rates, the Missouri Public Service Commission, referring to the electric service department of the utility as distinguished from the street railway, declared that an electric utility earning a return of 4.64 per cent in addition to a depreciation allowance of 3.5 per cent on the value of its property should obtain the increased revenue necessary for an adequate return through increased economy in operation and not through increased rates in a case where inadequate service has occasioned a loss in business and consequent loss of revenue and where an average return of 10.28 per cent was earned in the four years preceding the application and an average return of 9.15 per cent for a five-year period.

Proper Principles in Refunding Bonds.—Issues of refunding bonds should not exceed the total par value of the bonds refunded, according to a decision made by the Indiana Public Service Commission in an application by the United Public Service Company of Rochester, Ind., for approval of a new issue, as otherwise the mortgage indebtedness of utilities would be increased each time a refunding was negotiated. Outstanding bonds to the amount of $341,500 against property of the present value of $383,062 came much closer to the value of the property than sound financing can approve, the commission said. Bond discount should not be capitalized but amortized during the life of the bonds on which the discount is suffered.

Undesirability of Increasing Rates Where Contract Is of Recent Date.—The Missouri Public Service Commission has refused to grant relief to the St. Joseph Transmission Company, which operates between St. Joseph and Oregon, Mo., purchasing its energy supply from the St. Joseph Railway, Light, Heat & Power Company, although an increase in rates previously granted to the latter company is alleged to have operated to force the transmission company to do business at a loss. The commission's refusal is based on the fact that the contract between the St. Joseph Transmission Company and the city of Oregon was entered into as recently as January, 1918, when war conditions prevailed, and provided that the terms should not be modified or changed during the ten years which was to be the life of the agreement.

Importance of Adequate Depreciation Reserve.—In passing judgment upon the complaint of the city of Milwaukee against an increase in rates made by the Milwaukee Electric Railway & Light Company, the Railroad Commission of Wisconsin took occasion to reiterate its historic insistence on an adequate depreciation reserve, the sum set aside by the company under this head forming one of the points of attack. The commission declared that the rate of return fixed by it recognized the fact that the company will be able to invest a considerable portion of its depreciation reserve capital in permanent additions and improvements. For this reason, the commission continued, the rate of return required by the company on the fair value, which is in this case the cost new, need not be so high as would be the case were the funds for the construction of this property derived entirely from outside service. However, "it would seem to be perfectly clear that it would be inequitable to require the company to reduce the amount which it may charge to operating expenses for depreciation by the amount of interest on depreciation reserves and at the same time deduct these depreciation reserves from the amount upon which the company is allowed to earn."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Injury to Unauthorized Visitors to Plant Not Actionable.—In an action for damages for injuries received in an electric power plant owned by the village of Swanton, Vt., by a young boy while carrying breakfast to an employee of the plant, the Vermont Supreme Court held that, although hired by this employee to bring him his food, the boy was not on the premises as an invitee, expressly or impliedly, and that the owner of the plant had therefore no duty to insure his safety. The employee, although in sole charge of the plant at the hour when he desired breakfast, had no authority to invite an outsider to enter for reasons personal to himself. (109 A. 854.)

Penalty for Non-Service.—In a suit brought against the Vallejo Electric Light & Power Company under a statute since repealed but in force at the time of the failure to give service which is complained of, the plaintiff claimed the legal penalty of $50 as liquidated damages and $5 for every day that the refusal continued. The Supreme Court of California, overruling the judgment of the lower court, found against the company, though limiting the time for which damages must be paid to one year before action was brought. Whether the plaintiff had suffered loss to the amount of the penalty accrued had no bearing on the sum recoverable, which was fixed by statute at the amount named, and the fact that more than a year elapsed before suit was brought did not absolve the company from liability for the twelve months just preceding suit. (188 P. 999.)

Regulation of Public Service Commission in Ohio Affects Damage Suit in Indiana.—Suing in Indiana to recover damages for injuries received in Ohio, a freight-train conductor alleged the omission by the railroad employing him of precautions ordered by the Ohio Public Utilities Commission. The Supreme Court of Indiana ordered a new trial on the ground that the admission of the order of the Ohio commission by the trial court was erroneous. If the order was to be regarded as a general one, the court held that it was void for the reason that no legislative authority had been shown for the issue of such an order. On the other hand, if the order was specific in its nature, it had no binding force as against appellant because there was no evidence to show that the order was made after a hearing to which appellant was a party or served on appellant as required by law. (127 N. E. 146.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Thomas E. Murray, vice-president of the New York Edison Company, was the recipient of the degree of doctor of science from the Villa Nova (Pa.) College at its annual commencement exercises this year. Previously he had received the degree of doctor of laws from both the Brooklyn College and the Georgetown University. Mr. Murray ranks among the foremost men in the electrical industry. In addition to his association with the Edison company he is president of the Yonkers Electric Light & Power Company and vice-president of the United Electric Light & Power Company. He is a director of the Brooklyn Edison Company, the Electrical Testing Laboratories and the Manhattan Refrigerating Company, is the founder of the Metropolitan

THOMAS E. MURRAY

Engineering Company and of Thomas E. Murray, Inc., and has served in various capacities in virtually all of the electrical associations and engineering societies. For his research and productive work during the war he received a citation from the War Department. Mr. Murray's most noteworthy engineering achievements include the planning of the Waterside station of the New York Edison Company, the Sherman Creek and Hell Gate stations of the United States Electric Light & Power Company, the plants of the Brooklyn Edison Company and the hydro-electric development of the Chattanooga & Tennessee River Power Company. In 1910 the Franklin Institute awarded Mr. Murray the Edward Longstreth medal for his system of safety devices and protective appliances for interior electric wiring. Mr. Murray's patents number more than 350.

Charles F. Meigs, for the past eight years manager of the electric shop in Augusta for the Central Maine Power Company, has been appointed superintendent of the Augusta district.

Robert Montgomery, who has been manager of the commercial department of the Louisville (Ky.) Gas & Electric Company for the past seven years, has been appointed manager of the investment department of the same company.

David E. Huston has been appointed superintendent of the Columbus (Ohio) municipal electric light plant to succeed Lewis I. Rowe, resigned.

V. M. Fuller, formerly engineer in charge of the electrical construction of the hydro-electric plant of the Guantanamo (Cuba) Electric Company and more lately electrical engineer of the Compañia Electrica de Alumbrado y Traccion de Santiago (Cuba), has been appointed chief engineer of the latter company.

A. Hardgrave, president-elect of the Southwestern Electrical and Gas Association, is vice-president of the subsidiary companies of the American Public Service Company and in charge of the Southwest district of the Mid-West Utilities Company, with headquarters at Dallas, Tex. Mr. Hardgrave was born in Texas in 1881 and began his career as a trainman on the Fort Worth-Dallas Interurban. In 1907 he went to Memphis, Tenn., where he worked for two years with Stone & Webster. In February, 1913, Mr. Hardgrave entered the employ of Martin J. Insull, Chicago, for whom he made engineering and valuation reports in connection with the acquisition of utility properties. Three years later Mr. Hardgrave became engineer of operation and construction of the Mid-West Utilities Company, with headquarters in Chicago. He held this position until August, 1917, when

A. HARDGRAVE

he was transferred to Dallas. At that time the Mid-West Utilities Company decided to divide its territory and centralize control of operation and construction in branch offices. Dallas was made headquarters for the States of Texas, Oklahoma and Missouri, and Mr. Hardgrave was sent to Dallas to open the office. At the same time he was made vice-president of all the subsidiary companies of the American Public Service Company.

Arthur L. Kempster, heretofore traction manager of the street railways of the city of Seattle, has been appointed general manager of the New Orleans (La.) Railway & Light Company, succeeding John S. Bleecker, who has recently resigned that post, as announced in the ELECTRICAL WORLD. The lines of the New Orleans company are now in the hands of a receiver and Mr. Kempster has been engaged to study the traffic problems. A year ago he performed a similar service for the Brooklyn (N. Y.) Rapid Transit Company. Mr. Kempster has been connected with

ARTHUR L. KEMPSTER

the Seattle lines since 1891, and previous to his appointment as Seattle traction manager he was manager of the Seattle division of the Puget Sound Light & Power Company. Mr. Kempster will probably return to Seattle upon completion of his duties in New Orleans.

Obituary

Edwin W. Bakus, who assisted Marconi in financing the radio-telegraph in its early stages, died in Tarpon Springs, Fla., recently, aged seventy-two. Mr. Bakus had a varied and successful career as a backer of large industrial projects at home and abroad.

Carl Paul Berger, president of the Irvington Varnish & Insulator Company, Irvington, N. J., died on June 15. Mr. Berger came from Germany at the age of twenty-nine and in a year or so started a varnish and insulator factory. He was a pioneer in the manufacture of insulation and developed the use of black varnish for cable insulation. In addition he invented special machinery for varnishing cambric, silk and paper in continuous rolls. During the war he was active in supplying insulation to the Allies. His death came as the result of an attack of influenza.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Raw Materials in Good Supply to Fill Crane Orders

ACTIVITY in the electric crane market is beginning to ease off a bit for some producers, although others do not find this the case, and shipments of direct-current and 60-cycle alternating-current drive may be made in six to twelve weeks.

Because of the special nature of 25-cycle and 40-cycle equipment, some shops are quoting up to a year on shipments. In some quarters fairly good stocks of motors and control exist, but at the same time other producers are experiencing delays in receipt of this equipment.

Structural-steel stocks are in pretty good shape because in general this material forms the basis of the output of the other products of manufacture and fabrication of the same producers. Steel is moving in better volume now anyhow. Prices have undergone little change in the past few months, but there is a tendency upward, manufacturers say, although no definite change is anticipated at this moment.

The demand for alternating-current equipment is increasing in proportion to that for direct current, and some manufacturers' estimates place the present ratio somewhere between one to one and three to one in favor of the alternating current.

Electrical Exports for April Amount to $6,954,350

WHILE April exports of electrical goods as a whole were just under $2,000,000 less than those of the month of March, they were better than for either January or February. It will be remembered that returns for March placed that month on a very favorable footing compared with the best months of last year. Total electrical exports for 1919 amounted to $89,000,000, while the present year, at the end of the first third, is running at the rate of over $86,000,000.

In the $6,954,350 April returns, the outstanding features are seen to lie in dynamos and generators, fan motors, heating and cooking apparatus and interior wiring supplies. In these items the high month of March was surpassed. In comparison with April of 1919, increases were noted in exports of the same materials as given above, with the addition of metal-filament lamps, motors, rheostats and controllers and switching equipment.

	April		Four Months Ended April	
	1919	1920	1919	1920
Batteries	$547,430	$487,472	$1,893,386	$2,080,040
Carbons	102,642	84,967	552,033	429,724
Dynamos and generators	512,894	636,362	1,541,957	1,877,173
Fans	96,433	149,728	663,896	374,164
Heating and cooking apparatus	153,342	140,715	474,686	530,004
Insulated wire and cable	789,991	526,556	3,331,169	2,298,980
Interior wiring supplies	218,031	308,091	796,620	902,809
Arc lamps	2,889	699	6,105	2,049
Carbon-filament lamps	13,100	11,514	63,838	48,379
Metal-filament lamps	452,151	352,669	1,859,833	1,355,105
Magnetos, spark plugs, etc.	312,188	310,744	1,169,141	1,268,402
Meters and measuring instruments	248,890	181,663	1,102,162	796,905
Motors	829,113	923,096	3,455,711	3,730,451
Rheostats and controllers	30,798	66,389	134,241	244,325
Switches and accessories	230,840	272,680	822,973	1,304,550
Telegraph apparatus	106,769	44,394	353,092	306,078
Telephones	426,373	326,497	1,228,879	1,224,591
Transformers	308,669	169,976	1,468,368	1,162,720
All others	2,349,498	1,960,139	8,979,917	8,823,451
Total	$7,732,041	$6,954,350	$29,897,007	$28,759,900

For the first four months of the present year the total is only a little over $1,000,000 behind that period of last year, but noticeable gains are found in several important items. As a whole, the export situation can be considered quite satisfactory when there are taken into account the difficulties under which exports are now placed.

The figures in the table are by the Bureau of Foreign and Domestic Commerce.

Locomotive Headlight Units Gain in Industrial Field

MANUFACTURERS of steam-driven generators for locomotive headlight equipment are in general working to capacity in an endeavor to equip the steam railways before the first of July. Some roads report installations complete on all locomotives, while for others, which have been slow in placing their orders, deliveries will not be made by that date. Furthermore, a shortage in material parts has for some manufacturers held up shipments.

At the same time the demand for these steam turbine units has been increasing steadily in other fields outside that for which they were originally designed. Barges, dredges, locomotive cranes and other hoisting apparatus have proved a ready field, and their use has extended to mining and construction operations. One of the heaviest markets has been found in the oil regions, and here the applications have been more pronounced of late. In fact, so great has been this industrial field that at least one producer is making arrangements to add an industrial section to his manufacuring capacity.

Some of the 0.5-kw. and 1-kw. sets may be found in certain producers' stocks, but conditions are somewhat different as regards the larger sets. Up to 5 kw. they are being made for complete train lighting, but these have rather the least call for that purpose. It is expected, however, that these larger units will find still greater use in the industrial market.

Wage Controversy Affects Electric Sheet Allotments

ELECTRIC sheet mills are following different paths in regard to receipt of orders for shipment beyond June 30. Certain allocations of output for the third quarter have recently been made, but it has been estimated that the quantity available will meet only about half the requirements of the consumers. Where the remainder will come from is still to be seen, but it is hardly expected that production will be any better in the next three months than in the past three. At present a new freight tie-up threatens to make matters still worse. There has been some revision of prices, averaging around 15 per cent upward.

The wage agreement for sheet and tin-plate workers expires on June 30. From the deadlock which resulted from the meeting at Atlantic City last week of union sheet and tin mill owners and the Amalgamated Association, it appears that the operatives want no further conferences until the first week in September. Of course, the owners may undertake to operate as non-union concerns or to take the other course and close down.

A 20 per cent advance in base rates of scale and a six-hour day have been demanded. If a walkout is declared on July 1, shipments of sheets will be further delayed than they are now. An estimate gives the Amalgamated control of

about 40 per cent of the sheet and tin-plate mills, and in this number is a certain capacity in electric sheets. What the mills will do which have not already accepted allotments of their next quarter or half-year capacity remains to be seen when there are further results from the agitation of the wage question.

Malleable Situation Better, but Labor Is Still Short

IMPROVEMENT is reported in the malleable castings field. Present production has been estimated at between 60 and 80 per cent of capacity, where only a few weeks ago reports placed it at around 50 per cent. The chief factor in keeping it down is the labor shortage, particularly in the molding department. Here there are not enough molders to keep the other departments going to capacity.

Turnover in labor is high, and because of that and the independence of the worker rejections of material and defective work have been vital factors in the cost of malleable castings. Overhead costs on mill equipment have continued regardless of the capacity under operation. Prices on the finished goods have been tending higher all spring and summer, although malleable pig-iron quotations are the same today as they were the first of March. At the same time the demand is increasing.

A coal shortage is looming up now to put a more unsatisfactory aspect on the situation, while fresh walkouts in certain railroad yards in the East contribute still further to the chances of poorer shipments of malleables. Customers are driven to use such substitutes as steel, forgings, brass and bronze for the malleables, and at present there is little difference in price, with the main item of labor overshadowing the base metal prices.

Analysis of 1919 Carbon-Filament Incandescent Lamp Exports

CARBON-FILAMENT incandescent lamp exports during 1919 were valued at $202,597, which is only 4.3 per cent of the total valuation of all incandescent lamps exported. The highest monthly value was recorded in May, amounting to $44,157, of which $36,317 was credited to China. The average monthly rate of exportation was $16,883.

Data compiled by the ELECTRICAL WORLD indicate that the value of carbon-filament incandescent lamps imported by Canada from the United States was 67 per cent more than that imported by any other country, with a total of $60,025. China and Australia were second and third, with $37,000 and $27,004 respectively. Fig. 2 shows the relative value of exports to various countries importing carbon-filament lamps the value of which exceeded $5,000. Other countries importing this class of electrical apparatus were Argentina, Peru, Chile and the Dutch East Indies, their imports being valued at $2,475, $2,462, $1,517 and $784 respectively. A

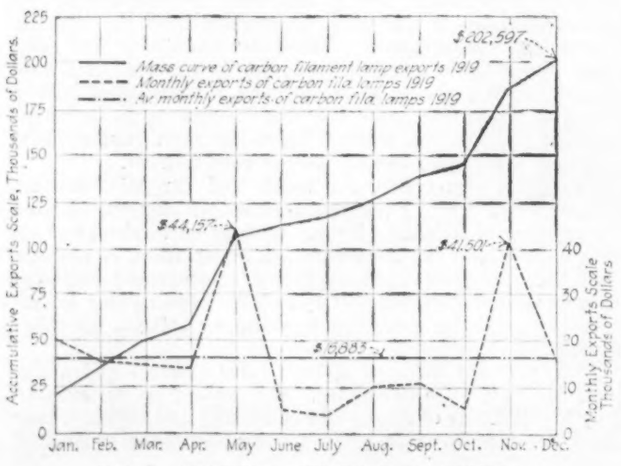


FIG. 1—MONTHLY VARIATIONS OF EXPORTS

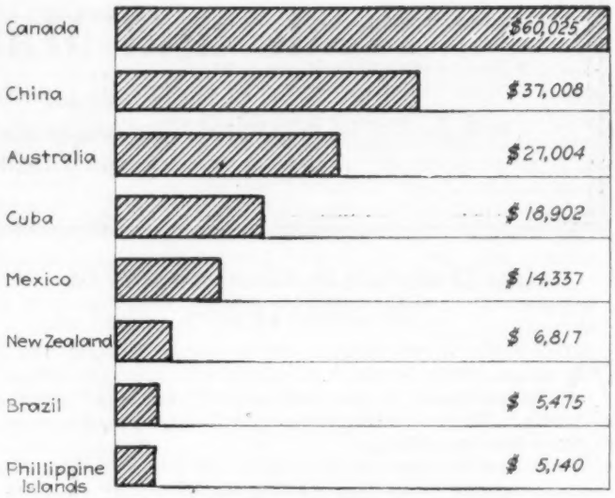


FIG. 2—ANALYSIS OF EXPORTS BY COUNTRIES

detailed study of the figures indicates that no carbon-filament lamps were exported to Europe. Continental America absorbed 65.5 per cent of the total exports, and Australia and New Zealand took 16.7 per cent. The remaining 17.8 per cent went to China, the Philippine Islands and the Dutch East Indies.

The above figures are based on export statistics issued by the Bureau of Domestic and Foreign Commerce for 1919.

Manufacturers Again Guaranteeing Against Fall in Price

AT THE close of 1918, when the armistice was signed, falling prices were looked for in many directions, and as a result there were many artificial methods employed to prevent buying from stopping. A favorite method in this connection was to guarantee the purchaser against a fall in prices.

Now that falling prices are again expected, the same uneconomical, panicky methods are again coming to light. In the appliance field the guarantee against fall in price is being used effectively to obtain fall business.

If the manufacturers by guaranteeing prices merely mean that they will pass along to the customer all saving in production costs during a certain period, there are many who will commend the action. On the other hand, it appears to be very unwise for any manufacturer to take upon himself the responsibility of guaranteeing his customers against a drop in price which probably will be brought about by conditions over which the manufacturer has no power. In this connection, a warning that agreements between manufacturers and dealers preventing the latter from reducing the selling prices of manufactured articles was unlawful was sounded last week by the Department of Justice as part of its campaign to lower the cost of living. The absence of formal contracts will not affect the provisions of the law, says the department.

District Stocks of Electric Tools in Good Shape

HEALTHY increases in the volume of sales of electric hand tools are reported from manufacturers of these specialties throughout the country. The heaviest market is found in the Central West, where automobile manufacturers are using them in ever-increasing quantities. Railway car and locomotive builders during the war placed heavy orders for this class of tool, and, because of long shipments and the general let-down in railway equipment building after the armistice, they were well supplied for the work in hand. It is expected, however, that recent plans for renewed activity in the railway field will result in further demands for electric tools. At the same time, this demand probably will be less than might at first be con-

templated from reports in circulation concerning the large amount of rolling stock to be purchased.

Sales this year have been heavy, but manufacturers have been able to keep fair stocks at their distributers' warehouses. It is still possible to make up shipments on ½-in., ⅝-in. and ¾-in. sizes from district stocks, but large orders, and orders for other sizes, are requiring three to four weeks to fill. Tool factories are not producing up to full capacity in all cases, one at least being on a 75 per cent capacity and one on zero because of strike conditions at the mill. Raw material and labor shortages are responsible for underproduction, it is reported. Motors have been very difficult to obtain in some cases, but with the use of motor trucks a sufficient quantity have been picked up to keep up to production schedule day by day.

Improvement in sales is coming from the garage business, and with it an increasing demand for universal motors.

Metal Market Situation

REGARDLESS of the offerings of copper at lower prices within the last few days, the underlying feature of the market is strength. Producers are still satisfied to hold their tonnage at 19 cents for June and July and 19.25 cents for August and September delivery. They feel that there must soon be a return of large consumers into the market, although this day is being put off because of manufacturing conditions. Transportation tie-ups are a cause of the conversion of less copper into finished goods, and this is being amplified by strikes in certain brass mills.

Whatever metal has recently been sold by some small dealers at around 18 cents and 18 and a fraction at the refinery is in small lots and has virtually no effect on the general market. There is not a great deal of metal in the outside market to apply on these low prices, and already after the first sales the prices advanced an eighth to a quarter cent.

Copper in the London market at the end of last week had declined to just over £82, but this week it has returned to £86. There is little activity in the foreign market, although contract copper is going out of the country in fair-sized lots. Port strikes have little effect on this class of material.

A strengthening tin market is shown in the recovery of Straits tin within the past week. It is now quoted at 50.50 cents for spot, an advance of 5 cents over a week ago, after a decline from well above 50 cents. The supply of spot in New York is light, but the demand too is not heavy. Strikes at tin mills are recent developments of moment.

Consumers and dealers are showing considerable interest in third-quarter zinc, and labor troubles at certain mills are providing some food for thought on future supplies.

Lead prices were further lowered to 8 cents by the main producers, although the outside market is quoting one-half cent higher. Spot stocks are low.

Scrap metals have fallen off a bit, heavy copper scrap declining ½ to 15 cents, heavy lead dropping a fraction, and old zinc scrap going a quarter below 5 cents.

NEW YORK METAL MARKET PRICES

	June 15	June 22
Copper	£ s d	£ s d
London, standard spot	86 5 0	86 15 0
	Cents per Pound	Cents per Pound
Prime Lake	18.50	18.50
Electrolytic	19.00	19.00
Casting	17.62½	17.62½
Wire base	22.50-23.00	22.50-23.00
Lead, trust price	8.25	8.00
Antimony	7.75	7.50
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Zinc, spot	7.95	7.85
Tin	45.50	50.50
Aluminum, 98 to 99 per cent.	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.50 to 15.75	15.00 to 15.50
Brass, heavy	9.00 to 10.00	9.00 to 10.00
Brass, light	7.00 to 7.50	7.00 to 7.25
Lead, heavy	7.00 to 7.37½	7.00 to 7.25
Zinc, old scrap	5.00 to 5.25	4.75 to 5.00

THE WEEK
IN TRADE

STOCKS in jobbers' hands are reported a little larger than last week. Here and there throughout the country fair shipments of pipe, loom, flexible armored conductor and cotton lamp cord have been received, and present embarrassments are taken care of temporarily. Meter stocks are about out, just enough being available to satisfy daily needs.

New England appears to be enjoying the heaviest volume of business and of new building of any section. The South is in good condition, too. At the same time collections are only fair, but show no cause for alarm at this time. Labor in some New England brass centers is again uneasy, and renewed walkouts of yardmen threaten shipping in the East.

NEW YORK

Jobbers' trade is on a high level, but is off somewhat from the volume of business of a month or more ago. Incoming shipments were better for a time, but the outlook is rather more unsatisfactory in light of fresh walkouts in freight yards in Baltimore, Trenton and Philadelphia.

Good sales have been made in fans, but the influence of the cool weather has been to permit jobbers to accumulate a fair stock. Even this is broken in some quarters and hardly expected to stand the strain of a real hot spell. Pipe, flexible conductor, porcelain and loom stocks are virtually depleted, while wire is in fair quantity. Cotton-covered lamp cord is found in volume in some places, but the silk variety is still low. Alterations and remodeling are holding a high place in building circles, and here and there are reported isolated large construction jobs. New residence work is off a bit. Collections are a little more difficult from the smaller companies.

Flexible Armored Conductor.—One large jobber reports the arrival of shipments ordered last October. Most distributers have no stocks on hand, while shipments arriving in driblets are cleaned out at once. Demand is as strong as ever. Prices for the two-wire No. 14 range from $115 to $121 per 1,000 ft.

Rubber-Covered Wire.—Demand is fair with good stocks on hand. Shipments are coming in fairly steady on back orders. Prices for No. 14 wire range from $11.60 to $14 per 1,000 ft., shading according to the size of order.

Rigid Conduit.—Stocks are in bad shape, with irregular shipments being applied on back orders of three to six months' standing. Demand is heavy at prices of $91 to $101 per 1,000 ft. for ½-in. black, and $197 to $220 for the 1-in.

Non-Metallic Flexible Conduit.—Demand is strong, especially in outlying districts, with virtually no stocks in sight, though occasionally distributers are fortunate enough to get in a shipment.

Lamps.—Deliveries from the factories are slow, with stocks consequently spotty. The situation has improved slightly, although 25-watt to 100-watt sizes are still hard to obtain. Demand is heavy.

Fans.—Demand picked up considerably, following the hot weather of last week.. Stocks are fair, with a shortage, however, of certain sizes. The most popular fan is the 16-in. oscillating, and a heavy run on ceiling fans is also reported.

Porcelain.—Deliveries are extremely slow, with unfilled orders running up to six months. Demand for knobs, cleats, tubes, etc., is strong, but prices are high and stocks depleted.

Safety Switches.—Jobbers report local territory as not offering so fertile a field for these switches as do other sections of the country. The market, however, is improving, and local stocks are in pretty good shape.

Dry Cells.—Sales are heavy with a slight increase recently. Orders are generally filled from stock, as shipments are coming through fairly regularly. Prices are firm, with no indications of a reduction in the near future.

Bells and Buzzers.—Reports on this material vary; jobbers' shipments are being applied on back orders as fast as they arrive, while at least one manufacturer is able to fill orders from stock and quotes one week on shipments. Demand is heavy, and there seems little likelihood of price reductions.

Transformers.—Demand does not seem to abate sufficiently to permit the shipments which are coming in to form into any kind of stock.

Lamp Cord.—Shipments are extremely long under a heavy demand. Certain jobbers have some in stock.

CHICAGO

Trade conditions in this district remain so badly jumbled that an intelligent discussion is difficult. The outstanding feature is that it remains impossible to secure goods in sufficient quantities to supply the demand, in spite of the fact that new orders are being received in considerably reduced volume. Sales of street-lighting equipment, pole-line equipment and railway supplies all show a reduction, while schedule-material orders are kept low by slack conditions in the building trades.

Brisk retail trade induced last week by the sudden advent of hot weather declined as suddenly as it jumped, following the return of unseasonable cool weather. Even the ordinary "June bride" trade in percolators, grills, toasters, etc., is below expectation. Contractors are kept fairly busy on alteration jobs, as many buildings are being remodeled and refitted to fill the demand for space, which is acute in all lines.

Jobbers report that failure to receive goods is not caused by inability to move goods from factory to jobber so much as to the difficulty manufacturers face in obtaining raw materials. This seems to apply particularly to power apparatus, as shipments of motors and similar items are moving with some ease. To sum up, the trade inclines to the opinion that conditions in general are even worse than for several weeks. Naturally collections are difficult.

Motors.—No improvement is noted in the situation as regards motors. All sizes are in demand, but the heaviest call is up to 20 hp., and the gross quantity carried on back orders is steadily increasing. Manufacturers are seriously impeded by lack of certain raw materials, and the situation shows no signs of immediate improvement.

Wire.—Wire stocks, in the ordinary sense, have long ceased to exist. All dealers are receiving occasional shipments, which last only so long as it takes to distribute them on orders. Supply is sufficient in all kinds except magnet wire to avoid any serious inconvenience.

Lamp Cord.—Cotton-covered cord is in fair supply, some jobbers being able to fill orders from stock. The silk variety is unobtainable. Manufacturers of heating appliances are reported as being seriously inconvenienced in some cases by the shortage of this material.

Fans.—Heavy demand by the retail trade, which started with last week's heat wave, has returned to ordinary proportions; meanwhile some deliveries have been made to jobbers, so that situation is somewhat relieved for the time. Hot weather will mean a return to former conditions of shortage.

Weston Instruments.—Owing to difficulties in securing supplies the Weston Electrical Instrument Company is not guaranteeing prices on any instrument ordered now. Deliveries range from six weeks, on items considered standard, up to sixteen weeks for special designs.

Plug Fuses.—These are available out of stock in limited quantities only. Present quotation of $5.60 per 100 on the 5-amp. size in lots of 500 or more shows no recent change.

Knobs, Tubes, Cleats.—Prices are unchanged, and demand, owing to lack of new construction work, is sufficiently light to allow jobbers to maintain some stocks. Deliveries from factory are slow, ranging up to four months.

Tape.—Stocks of tape, both friction and rubber, are fairly well maintained. In 100-lb. lots rubber tape is quoted at 73 cents per pound.

Porcelain Insulators.—These are almost unobtainable and have been subject to sharp advances. A double-petticoat, single-groove 5,000-volt insulator is now $17 per 100, and a 6,600-volt type with top groove is $24. These prices are not guaranteed.

BOSTON

Orders continue to pour into jobbing offices without slackening, although retailers report quieter buying of appliances. Stocks are irregular, and rail shipments are not as yet up to normal. Prices are firm, barring retail cuts on hollow ware to bring out trade and dispose of older designs of material. Deliveries are growing worse on motors of 10 hp. and below, but wiring materials are coming in better. Collections are fairly good, but are being closely watched. Payment in thirty days is being demanded on electrical accessories for automobile use, sixty days being sought on other accounts. Seasonal appliances are sluggish, on account of abnormally cool weather.

Building contracts to June 18 in New England total $167,680,000 since Jan. 1, compared with $72,802,000 for the same period last year. New industrial plant work, including extensions, is very active. Labor conditions are still uneasy, with strikes in the Naugatuck Valley holding back brass production. The Lynn Works of the General Electric Company opened Monday after a half week's shutdown in which shortage of material and fuel were features, combined with labor uncertainties.

Appliances.—Jobbers are complaining of long deliveries. Some retailers are actually selling 1920 Christmas goods ordered early in the year. Retail patronage has slackened during the past fortnight.

Rigid Conduit.—A few shipments are coming in and occasional small stocks are established, only to melt away in face of the demand for smaller sizes of pipe.

Wire.—Deliveries on weatherproof are quoted from eight to fourteen weeks on a 26.5-cent base, net price. Rubber-covered wire is moving on four to six weeks' delivery, with 25 to 26 cents base quotations. Bare copper wire in larger sizes can be had in two to three weeks, but the smaller sizes are harder to obtain, magnet wire being out of stock. Bare base, 23 cents net.

Flexible Armored Conductor.—Good stocks are in hand, No. 14 single-strip selling at $110 per M in 5,000-ft. lots.

Non-Metallic Flexible Conduit.—Plenty of loom is in hand at the moment, one medium-sized jobbing house reporting 100,000 ft. on its premises. Prices are steady, 5,000-ft. lots bringing $33.50 per 1,000 ft. in the ½-in. size and $36 for ¾-in.

Nail-it Knobs.—The famine appears to be broken. One jobber has just received 100 barrels, and quotes $35 per 1,000 in barrel lots.

Motors.—A leading distributer quotes forty weeks' delivery on 1-hp. to 7½-hp. motors, and another quotes nearly one year. Odd sizes are going fast when found. Prices are steady and the demand enormous.

Farm-Lighting Sets.—Inquiries are increasing. Bad roads and wet weather hurt spring sales. Stocks are low. A representative ¾-kw. set sells for $580 f.o.b. Boston and is quoted at three to four weeks' delivery.

Washing Machines.—Heavy sales have greatly reduced stocks, even of locally manufactured units. Galvanized-tank machines are moving a little faster than copper-lined outfits. Prices are firm.

Welding Apparatus.—Industrial demand is increasing. Deliveries are being quoted on a two to three weeks' basis.

Lamps.—Current demands are being met by splitting orders. The 25-watt size is somewhat scarce. The curve of orders continues to fall off somewhat, and vigorous efforts are being made to build up factory and warehouse stocks against fall business. Sign lighting shows new life.

Ranges.—High coal cost is reflected in good electric range sales. Stocks are low, with stiff price levels.

ATLANTA

A falling off of activities in the retail trade is reported this week, while a noticeable slackening in wholesale orders is reported by the jobbers. The volume of May orders is proving small compared with the average established for the first three months of the year. In the aggregate, however, it might be said that the wholesale and retail trade is satisfactory.

Industrial and building activity continues very good despite the high price of all building material and labor. Building permits for Atlanta for the first half of June have broken all previous records, and it is freely predicted that the building permits will pass the two-million dollar mark before the end of the month.

Jobbers report an increasing interest in all lines of electrical specialties, the demand for electric ranges being particularly heavy. A number of large cotton mills are seriously considering the installation of electric ranges in their mill villages, and if their decision is favorable, a large amount of this specialty will be required.

Collections are not so good as last week. Dealers in automobile specialties, the small contractors and the small central stations are the chief delinquents, while the large contractors and dealers are paying up promptly.

Fans.—A week of very hot weather has practically exhausted the supply of desk fans, particularly of the direct-current type, while ceiling fans have been very scarce for two weeks past. Jobbers predict a general shortage before the season has advanced materially as they expect no more fan shipments in the near future.

Distributing Transformers.—Conditions are unimproved in this line. Stocks are very spotty, and the popular sizes are practically unobtainable for quick service. Little hope is held out for immediate improvement in this situation.

Breast Drills.—Demand is on the increase and dealers report stocks moving well. Fair supplies are on hand and shipments are satisfactory.

Stamped Steel Boxes.—Shipments are arriving in fair quantities, some sizes being obtained from stock while others are as late as four weeks in shipment. The demand is still outrunning the supply, and it is not possible to accumulate any stocks of moment.

Armored Conductor.—Conditions in this line apparently have improved, though no stocks have been accumulated to date. Shipments are being received in increasing quantities, but receipts at present are absorbed by back orders on an allotment basis. Price, two-conductor No. 14, lots of 1,000 ft. to 2,500 ft., $116 per 1,000 ft.

Electric Vibrators.—A steady demand is reported throughout the territory. Stocks are in fair condition and shipments hold up well.

Washing Machines.—Stocks of washing machines continue to stand up well in the face of insistent demand. Shipments are coming through in good shape, owing largely to embargo on shipments East from factory locations, thus diverting products to Southern and Southeastern sections. List prices, standard machines, $125 to $150.

Conduit.—One jobber reports the receipt of 260,000 lb. for the Atlanta trade in the last two weeks, in assorted sizes from ⅜ in. to 4 in., galvanized. This shipment, in conjunction with receipts of other jobbers, has served to ease the local situation materially. Prices, less than 2,500 lb., galvanized, ½-in. $94.10; 1-in. $184.60; 1½-in., $298.70; 3-in., $830.80.

SEATTLE-PORTLAND

Trade conditions in the Seattle and Puget Sound field show little variation from those of several weeks past. Sales volumes, according to leading jobbers, have further declined, and anticipated business, particularly from logging and lumbering interests, is not materializing. It is believed that when the lumber mills make their usual midsummer shutdown in July, some sales of electrical apparatus, including fractional and larger sized motors, will be made. Retailers report that merchandising sales for the past week are still light. Activity in this district at present is largely confined to attempts to obtain goods already ordered rather than to placing new orders. Transportation troubles still perplex, although they have been mitigated to a slight degree. Maintenance of a fair semblance of stocks is next to impossible.

Non-Metallic Flexible Conduit.—Demand the past week increased, thus further depleting the already low stocks. Prices show no change.

Household Goods.—Push-buttons, annunciators, etc., recently advanced in price, but the demand in Seattle territory is showing a slight decrease. Stocks are very low and unless replenished in the immediate future will be practically exhausted.

Domestic Appliances.—An electrical demonstration week, staged by a large department store in Seattle, netted excellent results.

Meters.—In spite of the decreasing amount of residence construction, considerable difficulty is being experienced in obtaining sufficient meters to meet the demand. Some smaller sizes are still available, but shipments are lengthening for the larger types, which are quoted from four to six months.

Wire.—The shortage in popular sizes of weatherproof is still acute in Seattle and Sound cities. Stocks of larger sizes are fair. No price changes have been recorded recently. The superintendent of lighting in Seattle states that many local industries and most of the 63,000 consumers of municipal service will be automatically cut off within forty days unless additional fuel oil for the Lake Union steam auxiliary is obtained. The Shipping Board has been asked to furnish a tanker to transport fuel oil for the city's use.

SAN FRANCISCO

All California cities are making a special bid for industrial business. In this connection it is announced that Los Angeles will soon be the center of a big cotton market, the cotton being grown in the adjacent Imperial Valley. The Imperial Valley crops of all kinds, it is said, will be marketed for about $75,000,000 during the season. At the "electrical home" of the California Electrical Co-operative Campaign, opened near San Francisco, the value of numerous and well placed outlets is being forcibly impressed upon the visitors.

Household Devices.—Recent advances in the price of heating appliances are causing considerable confusion and recrimination among dealers, many of whom bought before advances became effective, and are disposed to sell at the old prices.

Ranges.—Several large government orders have been recently awarded. The city of San Francisco is in the market for a battery of six hotel ranges for its Hetch-Hetchy installation. Deliveries from the factory average about four months. Water heaters are especially slow in coming through.

Washing Machines.—Inability of certain manufacturers to make deliveries threatens a readjustment of agencies, though few changes are actually reported. Most jobbers seem anxious to retain their present lines.

Farm Plants.—Considerable stocks have accumulated on the Coast as a result of Eastern embargoes on freight, but these stocks are met by still larger demands. Considerable export business is being done, especially in the Philippines. Agents report this to be rather a dull season, as farmers have no time to talk such appliances during the period of harvesting.

Rubber-Covered Wire.—Coast stocks are exceptionally good. The call has dropped off somewhat because of the completion of outstanding wiring jobs. The present price of No. 14 single braid solid in 5,000 ft. lots is $12.30 per 1,000 ft. for California terminal points.

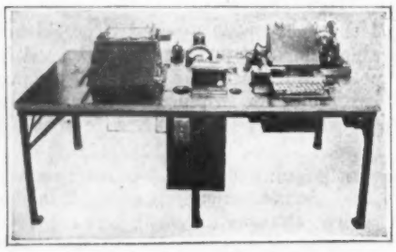
Insulating Material.—The market for such rewinding and repair specialties as mica, fiber, etc., is much quieter than in 1919. Prices are fairly steady, although a recent 10 per cent advance has been effected in micanite plates.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Automatic Printing Telegraph

To get greater speed in duplex transmitting and receiving, the Kleinschmidt Electric Company, Inc., Brooklyn, N. Y., has improved its current

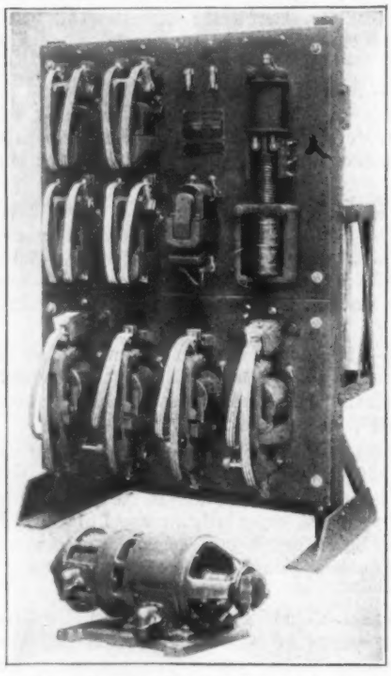


FEWER PARTS USED THAN IN FORMER MODELS

model of automatic printing-telegraph apparatus to eliminate one-third the number of parts previously used. Speed of operation can be boosted up to eighty words per minute, the maker says.

Control for Alternating-Current Elevator Motors

To meet the heavy requirements of alternating-current motor control for elevator service, where high speed and

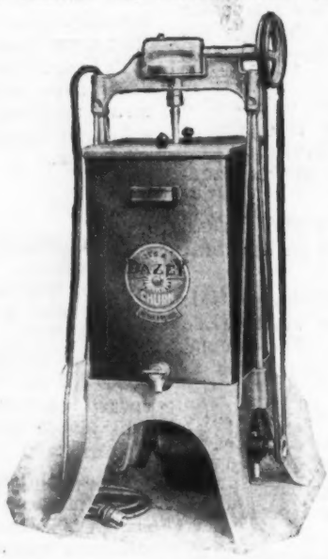


DIRECT CURRENT OPERATES MAGNETS FOR ALTERNATING-CURRENT MOTOR

large capacity motors are used, the Warner Elevator Manufacturing Company, Cincinnati, Ohio, has designed its type CA controller. The contactor magnets together with the brake magnets are operated by direct current obtained from a small motor-generator set. Main-line and direction switches are operated by a self-centering car switch, and full control in both directions is obtained with three wires to the car. Direction switches are mechanically interlocked.

Electrically Operated Churn

The Dazey Churn & Manufacturing Company, St. Louis, Mo., has placed on the market its motor-driven butter



MOTOR REPLACES FORMER HAND POWER

churn. The churn itself is similar to the company's hand-operated model. Gross capacities of these new machines are 4, 6 and 10 gal. Gears are inclosed in a removable housing.

Drum-Contactor Controllers for Direct-Current Motors

The Westinghouse Electric & Manufacturing Company has designed a type S manually operated drum controller, employing practically the same principle of operation as magnetic contactor controllers. They are used for starting and adjusting the speed of shunt, series and compound-wound motors by adjusting the resistance in series and parallel with the motor armature. The contactors are operated by cams mounted on the controller shaft, and line contactors, which open and close the main-line circuit, are protected by magnetic blow-outs. Each contact element is complete in itself and can be removed as a unit. The stationary and moving contacts are identical and are interchangeable with those of Westinghouse auto-starters and magnetic-contactor controllers.

The controllers will operate when mounted in any position, as the contactors are spring-actuated and their operation is not affected by gravity. Controllers for use with crane hoists regulate the speed of the motor while lowering by dynamic or regenerative braking. The motor may also assist in the lowering.

Electric Cigar Lighter

The continuous-duty type of electric cigar lighter for counter service is designed for 110-volt circuits and con-

CONSUMES 40 WATTS ON 110-VOLT SERVICE

sumes 40 watts, according to the manufacturers, Clark, Osgood & Allison, Inc., Munsey Building, Washington, D. C. This "Duralectric" lighter uses a nickel-chromium alloy element with mica and special asbestos composition and is finished in mahogany with nickel trim.

Portable Jig Saw

A motor-driven portable jig-sawing machine is being marketed by the Clapp-Eastham Company, Cambridge, Mass. The motor is of ⅓ hp. for 110-

ONE-SIXTH HORSEPOWER DRIVE

volt or 220-volt service, and a two-step pulley provides speeds of 500 and 800 r.p.m. The blower is automatically adjusted to clear the work of dust.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution
Together with Trade Personals and Notes on Foreign Trade,
Jobbers' News and New Trade Literature

THE MARTIN-WRIGHT ELECTRICAL COMPANY, San Antonio, Tex., electrical contracting engineers, will soon open a branch office in Dallas, Tex.

THE NORTH CENTRAL ELECTRIC ASSOCIATION MEETS.—The first convention of the North Central Electric Association, which is a consolidation of the Minnesota Electric Association and the Electric Power Association of South Dakota, was held at the Hotel Radisson, Minneapolis, Minn., June 15, 16 and 17.

THE YOST ELECTRIC MANUFACTURING COMPANY, Toledo, Ohio, has opened a branch factory in Ironville. The new works are in the Shepler paper-mill plant and will start with 100 employees.

DIENELT & EISEHARDT, INC., 1304-18 Howard Street Philadelphia, manufacturer of power hammers, hydro-extractors, etc., has discontinued its electrical department.

WHITFIELD P. PRESSINGER, New York City, vice-president of the Chicago Pneumatic Tool Company, died June 19 as a result of complications following an operation. He was actively engaged in the pneumatic tool and allied machinery industry for many years. For seven years he was manager of the Clayton Air Compressor Company and became widely known through numerous activities in the American Society of Mechanical Engineers and the Compressed Air Society.

B. G. PRYTZ has resigned as president of the SKF Industries, Inc., New York City. He has been elected managing director of the parent company, with headquarters at Gothenburg, Sweden. F. B. Kirkbride, vice-president since the organization of the company, has been appointed president to succeed Mr. Prytz.

A. J. BIBIGHAUS, consulting engineer, has opened an office at 530 Hamilton Street, Allentown, Pa. He has been connected with several large corporations as an electrical and mechanical engineer, including Thomas A. Edison, Inc., Ingersoll-Rand Company, Phillipsburg, N. J., and the electrical department of the Bethlehem Steel Company.

J. K. ALLINE, formerly of the Electric Appliance Company, Chicago, has been appointed Iowa representative of the Packard Electric Company, Warren, Ohio.

G. B. ROSENBLATT, specializing in the commercial and technical activities of the Westinghouse Electric & Manufacturing Company in the West, with respect to metal mining and smelting, coal mining, oil and electrometallurgical and electrochemical industries, has transferred his headquarters from the Salt Lake City (Utah) office to the San Francisco office.

JOHN McC. PRICE, formerly general sales manager for the Mechanical Appliance Company, Milwaukee, has been recently appointed manager of the Chicago district office of the Industrial Controller Company, Milwaukee, Wis.

E. O. SESSIONS resigned as president of the General Devices & Fittings Company of Chicago on May 1, 1920. Mr. Sessions had not been active in the company since the beginning of the war, and he sold all of his holdings in order to devote his entire attention to the work of the Sessions Engineering Company, of which he is president.

THE GREAT LAKES ELECTRIC MANUFACTURING COMPANY, Chicago, manufacturer of small motors, generators and rotary converters for special purposes, has moved from 200 N. Desplaines Street to 11-17 South Desplaines Street, where the increased space will permit the company to triple its output.

THE DAZEY CHURN & MANUFACTURING COMPANY, St. Louis, Mo., has motionized its churns and is selling them through jobbers.

THE GENERAL LEAD BATTERIES COMPANY, Newark, N. J., announces the purchase of a two-story and three-story building of 65,000 sq.ft. area at Eightieth Street and Belt Line Railroad, Chicago, for manufacturing and storage purposes.

THE GEM ELECTRIC COMPANY, Santa Ana, Cal., has recently been organized by D. J. Keleher, formerly with the engineering department of the Southern California Edison Company, and J. F. Ireland, formerly with the American Aluminum Company of America, to do an electrical contracting business and to deal in electrical appliances and supplies.

THE CHICAGO PNEUMATIC TOOL COMPANY, Chicago, Ill., announces the election of Allan E. Goodhue as vice-president in charge of sales. Mr. Goodhue became associated with the company Jan. 1, 1919, and since May 1 of that year has

ALLAN E GOODHUE

been managing director of the Consolidated Pneumatic Tool Company, London, England, the English subsidiary of the company, and also director of European sales for the Chicago Pneumatic Tool Company. He was for a number of years connected with the sales department of the Midvale Steel Company and the Midvale Steel and Ordnance Company in Philadelphia, Chicago and Boston, leaving that company in March, 1918, to enter the service of the United States Government.

THE MECHANICAL APPLIANCE COMPANY, 133 Stewart Street, Milwaukee, Wis., manufacturer of electric motors, electric controlling devices, etc., has increased its capital stock from $350,000 to $750,000. Extensions are contemplated to the main works of the company.

THE ENGBERG ELECTRICAL COMPANY, St. Joseph, Mich., has sold its plant and business to A. W. and E. C. Filstrup, who control the Covel Manufacturing Company, Benton Harbor, Mich.

THE EDISON ELECTRIC APPLIANCE COMPANY, 5660 West Taylor Street, Chicago, has awarded contract for a one-story boiler house, 63 ft. x 91 ft., to cost about $35,000.

THE ECONOMY FUSE & MANUFACTURING COMPANY, Chicago, announces the appointment of F. L. Easton as district sales manager of its Denver office, 205 Commonwealth Building, Denver, Col. Mr. Easton succeeds R. M. Olsen, who resigned recently. Mr. Easton formerly was connected with the Economy company, but more recently has been doing sales-promotion work for the Gates Rubber Company.

THE SERVICE CASTING COMPANY has recently been organized at Blanchester, Ohio, and will specialize in making small gray-iron castings for the trade. The foundry has been in operation since Feb. 1, 1920, doing contract work. The personnel consists of R. B. Huyett and Charles N. Secrist, both of wide experience in foundry and machine practice.

THE LAUNDRYETTE MANUFACTURING COMPANY, Cleveland, Ohio, has under construction a two-story-and-basement addition, 80 ft. x 140 ft. It is expected that this will enable production of its washing machines to be doubled.

THE ART LAMP MANUFACTURING COMPANY, 521 South Wabash Avenue, Chicago, has purchased a building at the corner of Throop and Fifteenth Streets, to be utilized for the manufacture of lamps.

THE UNITED STATES ELECTRIC MANUFACTURING CORPORATION, New York City, has removed its plant from 116 Duane Street to 476 Broadway.

THE RELIANCE LIGHTING FIXTURE CORPORATION, 317 Canal Street, New York City, has been organized to take over the property and holdings of the Reliance Electric Lamp & Supply Company. The company is considering moving into large quarters in the near future.

THE CHARLES R. ABLETT COMPANY, New York City, manufacturer of miniature and standard incandescent lamps, has moved from 50 Church Street to 199 Fulton Street, where it will have much larger quarters, enabling the company to combine its office and warehouse under one roof.

THE RELIABLE ELECTRIC COMPANY, manufacturer of telephone and switchboard protection equipment, switches, auto fuses, etc., is now established in its new factory at 3133-45 Carroll Avenue, Chicago.

THE POWER PLANT SUPPLY COMPANY, 707 Canal Road, Cleveland, Ohio, has recently been organized to deal in power-plant equipment and pumping machinery. William E. Berrington is secretary and manager.

THE CALIFORNIA ENGINEERING COMPANY has opened offices at 131 Leidesdorff Street, San Francisco, Cal., for investigating and reporting on problems in civil, electrical, mechanical, hydraulic and marine engineering fields; also the organization, development and management of engineering projects. Paul B. McKee is president of the company and Paul R. Barker is vice-president and chief engineer.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., will soon award contract for the erection of an addition to its plant at Lynn, Mass., to cost about $100,000.

THE CENTRAL MANUFACTURING COMPANY, 2525 Montgomery Street, St. Louis, Mo., has recently been organized to take over the property and business of the St. Louis Washing Machine Company. The Central company is now established in its new factory. M. Cohn is president and treasurer.

GEORGE P. MILLS, formerly electrical sales engineer of the General Electric Company, Philadelphia, has joined the staff of the Electric Furnace Construction Company, Philadelphia, to take charge of and develop electrical industrial heating furnaces.

THE HAYS SCHOOL OF COMBUSTION, 1412-14 South Michigan Avenue, Chicago, has published a book entitled "Opportunities for the Combustion Expert," in which it gives consideration to the subject of preventable waste of fuel and the installation of mechanical apparatus to check the amount of fuel used.

WILLARD S. SISSON, secretary and treasurer of the D. & W. Fuse Company, severed his connection with the D. & W. on June 15. He will continue in the electrical business and will announce his plans in the near future.

Supply Jobbers' Notes

THE SIEGAL ELECTRICAL SUPPLY COMPANY, a jobbing company at 156 West Washington Street, Chicago, has opened a retail store at the same address. The wholesale and retail branches of the business will be conducted separately.

THE WESTERN ELECTRIC COMPANY, 195 Broadway, New York City, has taken over the distribution of the products of the King Manufacturing Company, St. Joseph, Mo., to replace the George Cutter Company's line of goods.

THE CENTRAL ELECTRIC SUPPLY COMPANY, 204 West Randolph Street, Chicago, has been organized by Herman Landerman, formerly of the Washington Light Company, Chicago, and Harry London, formerly of the Peerless Light Company, New York and Chicago. The new company is a distributer and jobber of electrical merchandise, including chandelier and fixture parts.

Foreign Trade Notes

SPANISH AND ITALIAN CAPITAL PURCHASES GERMAN POWER PLANT IN BUENOS AIRES.—Announcement has been made recently in the Argentine press that Spanish and Italian capital has purchased the interests in Argentina of the Compañia Alemana Transatlántica de Electricidad, a German company supplying electric power to Buenos Aires.

THE SWISS ANNUAL SAMPLE FAIR.—At the fourth annual Swiss sample fair, held in Basle during April, the majority of the electrical apparatus stands displayed articles for household use, especially cooking and heating devices. The coal crisis has led Swiss electrical equipment firms to develop a large number of new devices for the utilization of electricity.

THE WORTHINGTON PUMP CORPORATION is planning to make extensive additions to its plant in Berlin, Germany, to meet the increase in business expected as soon as conditions become settled in that country. The company, it is understood, has orders on hand for a year in advance, all sold in Germany.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A construction engineer in Denmark (No. 33,071) desires to purchase electric light bulbs, etc.

A merchant firm in England (No. 33,077) desires to secure agencies for the sale of electrical goods, etc.

A general merchandising company in India (No. 33,085) desires to secure an agency and purchase on its own account electrical goods, etc.

An agency is desired by an import association in Italy (No. 33,026) for the sale of electric lighting and industrial supplies, etc.

A firm of merchants in India (No. 33,035) desires to secure an agency for the sale of electrical goods, etc.

An inquirer in Peru (No. 33,062) wishes to secure prices on an electric motor to operate a machine for grinding clay, having a capacity of from 6 to 7 tons per day.

Trade Publications

THERMOELECTRIC POWER.—Bulletin No. 12, entitled "The Thermoelectric Power of Thermocouples," has been issued by the Pyroelectric Instrument Company, 636 East State Street, Trenton, N. J.

MOTORS FOR CRANE AND HOIST SERVICE.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 48119.1, describing its alternating-current motors for crane and hoist service.

SMALL ELECTRIC MOTORS.—Bulletin No. 57, issued by the Persons Electric Company, Quincy, Ill., describes its type G-I alternating-current motors and type G-D direct-current motors.

WATT-HOUR METERS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued a miniature catalog in which it describes and illustrates its different types of watt-hour meters.

EXPANSION JOINTS.—The Griscom-Russell Company, 90 West Street, New York City, is circulating bulletin No. 1010, describing its G-R expansion joint for use on low-pressure steam lines.

FURNACE TEMPERATURES.—The Bureau of Standards, Department of Commerce, Washington, D. C., is distributing a copy of Technologic Paper No. 159, entitled "Porosity and Volume Changes of Clay Fire Brick at Furnace Temperatures."

FLEXIBLE SHAFTING.—Bulletin No. 3, entitled "Coates Flexishaft," published by the Coates Clipper Manufacturing Company, Worcester, Mass., describes flexible shafting for portable motor-driven tools.

New Incorporations

THE CONEMAUGH (PA.) POWER COMPANY has been chartered with a capital stock of $6,000 to operate an electric light and power plant in Conemaugh. L. B Saylor, Johnstown, is treasurer.

THE HUSTONVILLE (KY.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $12,000 by J. W. Hoskins, W. J. Childress and A. J. Adams.

THE OKLAHOMA ELECTRIC COMPANY, Muskogee, Okla., has been chartered with a capital stock of $10,000 by J. V. Chappel, L. O. and L. F. Hunt.

THE SUBURBAN LIGHT & POWER COMPANY, Cleveland, Ohio, has been incorporated with a capital stock of $5,000 by A. C. Pratt and others.

THE McARTHUR (OHIO) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000 by L. W. Sprague, O. F. Pilcher, A. Will, Jr., and O. E. Vollenweider.

THE TRAVELLER'S REST (KY.) ELECTRIC LIGHT & POWER COMPANY has been incorporated with a capital stock of $3,000. The officers are H. Y. Thackston, president, and George W. Johnson, secretary and treasurer.

THE LARWILL (IND.) LIGHT & POWER COMPANY has been incorporated by George W. Stirling, Edward F. Rush and S. S. Trachsel. The company is capitalized at $15,000 and proposes to generate and distribute electricity for lamps, heaters and motors.

THE HELMS-DAM COMPANY, Fortville, Ind., has been chartered with a capital stock of $25,000 to maintain and operate water power to generate and distribute electricity. The directors are: George McCarty, Emerson Getner and William E. Morse.

THE ARIZONA ELECTRIC POWER COMPANY, Winslow, Ariz., has been incorporated with a capital stock of $200,000 to generate and distribute electricity for lamps, heaters and motors, to construct and operate telephone systems, etc. The incorporators are W. C. Quebedeaux, O. J. Faulkner and E. A. Sawyer, all of Winslow.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BOSTON, MASS.—The Edison Electric Illuminating Company, 70 State Street, is having plans prepared for the erection of a substation on Broadway.

BOSTON, MASS.—The installation of arc lights on Saratoga Street, between Breed Square and Wadsworth Street, East Boston, is under consideration.

BRISTOL, CONN.—The installation of a "white way" street-lighting system is under consideration.

NEW LONDON, CONN.—Work will soon be started by the American Bridge Company to install two electrical units in place of the steam power now used to operate the Thames River highway bridge. The cost is estimated at about $500,000.

WALLINGFORD, CONN.—Improvements and extensions are contemplated by the International Silver Company, State Street, Meriden, to its power house at the Wallingford plant, to cost about $25,000.

Middle Atlantic States

NEW YORK, N. Y.—S. W. Straus & Company are having plans prepared by Warren & Wetmore, architects and engineers, 10 East Forty-seventh Street, for the erection of a bank, office and store building on Fifth Avenue and Forty-seventh Street, to cost about $4,000,000.

YONKERS, N. Y.—The Yonkers Electric Light & Power Company is having plans prepared by William Whitehill, architect and engineer, 55 Duane Street, New York, for the erection of a substation, to cost about $150,000.

NEWARK, N. J.—M. Straus & Sons, 508 Frelinghuysen Avenue, have had plans prepared for the construction of a new power house to be used in connection with their leather works. The cost is estimated at about $30,000.

NEWARK, N. J.—Bids have been received by the Board of Education for the new Seymour Vocational School, to cost about $1,125,000, exclusive of equipment. Plans include a complete machine shop, electrical plant, etc.

NEWARK, N. J.—The erection of a power house, to cost about $20,000, at the Soho Hospital is under consideration.

PERTH AMBOY, N. J.—In connection with the operation of a new dry dock at its plant, the Perth Amboy Dry Dock Company, foot of Broad Street, contemplates the installation of electrically operated pumping machinery, valves, a yard flood-lighting system, etc.

TRENTON, N. J.—Bids will soon be received by the City Commission of Trenton for the installation of a new 25,000,000-gal. pump and a new 1,000-hp. steam turbine-driven generator for the municipal waterworks.

BLAIRSDALE, PA.—Bids have been received by the Western State Hospital for the Insane, at Torrance, for the first unit of construction work on a farm colony, to cost about $150,000. Plans include the erection of administration and ward buildings, power house, etc. F. M. Crooks, Jones Law Building, Pittsburgh, Pa., is architect.

FORD CITY, PA.—Bids will be received by the clerk of the Council until June 29 for the erection of an addition to the power house. Douglas & McKnight, Columbia Bank Building, Pittsburgh, Pa., are engineers.

HARRISBURG, PA.—An ordinance providing for ten arc and sixty-five incandescent lights has been passed by the City Council.

PHILADELPHIA, PA.—Plans are being prepared by Hoffman & Henon, architects, Finance Building, for the erection of a theater and office building, to cost about $1,000,000, for the Stanley Company of America, 1214 Market Street.

YORK HAVEN, PA.—The installation of new electric machinery and other equipment at its plant is contemplated by the York Haven Paper Company.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company, Lexington Building, it is understood, is planning the erection of an addition to its substation in the vicinity of Graves and Constitution Streets.

HAMPTON ROADS, VA.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., contemplates the installation of an electric underground distribution system on Block Z (Specification 1240), to cost about $38,000.

SCHOOLFIELD, VA.—A fire station is being erected by the J. A. Jones Construction Company of Charlotte, N. C., for the Dan River & Riverside Cotton Mills. Equipment to include central switchboard, battery stand and a fire-alarm system will be required.

North Central States

BAY CITY, MICH.—The Wildman Rubber Company, 816 Book Building, Detroit, contemplates the erection of the first unit of a new tire plant along the Saginaw River, to cost about $1,000,000. Plans include power house as a separate unit. The total cost of the plant is estimated at about $10,000,000.

DETROIT, MICH.—Contract will soon be awarded by Hugo Scherer, care of Louis Kamper, architect, 749 Book Building, for the erection of an office and loft building, to cost about $1,000,000. Electric lighting equipment and electric elevators will be installed.

IRONWOOD, MICH.—Bids will be received by the Board of Water Commissioners, at the office of the Ironwood Waterworks, until June 28, for centrifugal pumping equipment, six units, motor and gasoline-engine driven, to be used in connection with the erection of new waterworks.

MARQUETTE, MICH.—A new radio station will be erected on the government land between the Coast Guard station and the lighthouse point.

AKRON, OHIO.—The City Council is considering an issue of bonds to the amount of $1,000,000 for the purpose of erecting and maintaining a municipal power plant.

CANTON, OHIO. — Stockholders of the United Electric Company will vote on the question of issuing $1,000,000 preferred stock and 30,000 shares common stock, the proceeds to be used to make further improvements to the plant.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases, Room 219, City Hall, until July 2, for furnishing and installing complete in place three motor-driven vertical centrifugal pumps with motors, electrical equipment, etc. A deposit of $5 is required for plans and specifications, which may be obtained at the office of the commissioner of engineering, Room 618, City Hall.

EAST LIVERPOOL, OHIO. — Work is under way on the construction of a new $60,000 substation for the Buckeye Power Company at Second and Washington Streets. Frank Howard, Wheeling, W. Va., general superintendent of construction, is in charge.

MANSFIELD, OHIO.—Contract has been awarded to the McClintic Marshall Company, Oliver Building, Pittsburgh, Pa., by the Ideal Electric Manufacturing Company, for the erection of an office building and a factory at Mansfield, to cost about $350,000.

ECHOLS, KY.—The Louisville Gas & Electric Company plans to rebuild its power plant and coal tipple, recently destroyed by fire.

BLUE RIVER, WIS.—The Byrds Creek Electric Light & Power Company contemplates the erection of an electric transmission line from Blue River to Eagle Corners.

HILBERT, WIS.—The municipal electric light plant, it is reported, has been recently destroyed by fire.

ALGONA, IOWA.—Petition has been made to the State Public Utility Commission by the Cresco Light & Power Company for permission to erect and maintain poles, wires, electric transmission lines to serve territory adjoining Algona.

BISMARCK, N. D.—Bids will be received by the Board of City Commissioners until July 12 for the complete construction of a waterworks system. Equipment includes motor-driven centrifugal pumps, etc. A deposit of $25 is required for plans and specifications, which may be obtained from T. R. Atkinson, consulting engineer, Bismarck, N. D.

HAVEN, KAN.—New bids will be received by M. Barrachmen, clerk, until July 1, for the erection of an electric transmission line from Haven to Burton.

MOUNT HOPE, KAN.—Bids will be received by George H. Troop, city clerk, Burton, until July 1 for the erection of an electric transmission line from Mount Hope to Burton. Former bids have been rejected.

NORTON, KAN.—Contract will soon be awarded by the State Tuberculosis Hospital for the erection of a commissary building, addition to power house, etc. Plans include the installation of engine and generator, switchboard, electric cable, storage battery and electric wiring in the commissary building. The cost is estimated at about $30,000. J. A. Kimble is state manager.

Southern States

BAMBERG, S. C.—An election will be held on July 15, for the purpose of submitting to the voters an issue of $15,000 in bonds to repair and enlarge the municipal electric light plant.

COLUMBIA, S. C.—The Columbia Railway, Gas & Electric Company contemplates the erection of an addition to its local power plant, to cost about $400,000, including equipment.

ENOREE, S. C.—An electric power system to include an individual motor drive and two generators will be installed at the Enoree Mills.

GREENVILLE, S. C.—The Campedown Mills contemplate the installation of an electric power system, including individual motor drive for looms and spindles. J. E. Sirrine is engineer.

COLUMBUS, GA.—The installation of an additional unit at the Goat Rock power plant of the Columbus Power Company is being made, at a cost of about $500,000, to include the erection of a transmission line to North Highlands.

CENTERVILLE, TENN.—The erection of a municipal electric light plant to cost about $5,000 is under consideration by the city officials.

CHATTANOOGA, TENN. — The Brock Candy Company contemplates additions, to include the erection of a new power house, installation of boilers rated at 300 hp., air compressors, etc.

NASHVILLE, TENN.—Bids will be received at the office of J. W. Dashiell, secretary of the Board of Commissioners, City Hall, until June 30, for the designing, construction and erection of a 20,000,000-gal. turbine-driven centrifugal or steam-actuated equivalent condensing high-service pumping engine and two 20,000,000 gal. low-service centrifugal pumps, to be engine-driven or otherwise. Specifications may be obtained at the office of Commissioner of Waterworks, City Hall.

BIRMINGHAM, ALA.—Plans are under consideration by the Alabama Power Company for additional hydro-electric power development to include two power plants, one on the Tallapoosa River and the other on Little River near Blanche.

MONROE, LA.—Plans for the erection of a municipal electric light plant and waterworks include the installation of one 1,000-kw. and one 600-kw. turbo-generator, electrically driven pumps, etc., to cost about $225,000. The Foundation Company, 223 Broadway, New York, N. Y., are general contractors.

OPELOUSAS, LA.—Bonds to the amount of $250,000 have been voted for improvements and extensions to the electric light, water and sewer systems.

BRONCO, TEX.—The Lovington Public Utilities Company of Lovington, N. M., contemplates the construction of a local electric light and power plant.

McKINNEY, TEX.—The central generating plant of the Texas Power & Light Company, near McKinney, was damaged to the extent of $10,000 due to a gas explosion.

Pacific and Mountain States

ANACORTES, WASH. — The Empire Power Company has been recently incorporated for the purpose of developing water power at two locations, one on the Skagit River just below the Seattle power site and the other on the Cascade River, 2 miles from Marblemount. The projects are capable of developing 30,000 hp. H. A. Hull is president.

BURNS, ORE.—Louis C. Kelsey, consulting engineer of Portland and Nampa, Idaho, has been retained by the city officials to prepare plans and supervise the construction of the proposed municipal electric lighting plant.

KLAMATH FALLS, ORE.—The California-Oregon Power Company is considering the formation of a new company to take over the holdings of the corporation, financing the deal by an issue of $10,000,000 in bonds, of which $1,842,000 would be sold at once and proceeds used for improvements.

AVALON, CAL. — Application has been made by the Pacific Telephone & Telegraph Company for a franchise to operate a local telephone exchange.

BERKELEY, CAL.—Bids will be received by the Board of Education, 2133 Allston Way, until June 29, for furnishing and installing deep-well pumping head, motor, electric power connections, etc., at each of three schools.

LOS ANGELES, CAL.—The Gore Brothers plan the construction of a theater on Hollywood Boulevard, to cost about $500,000. A. B. Rosenthal, Douglas Building, is architect. The same parties contemplate the erection of a similar building at 550 South Main Street, to cost about $2,000,000.

LOS ANGELES, CAL.—Plans are under way for the installation of an ornamental street-lighting system in the Los Cerritos district, to cost about $35,000.

LOS ANGELES, CAL.—Authority has been granted to the Southern California Edison Company to issue $5,000,000 in bonds to carry on development work. The company estimates that over $8,000,000 will be necessary to defray expenses for the construction of hydro-electric plants, transmission and distribution lines up to 1921, as follows: To complete Kern River plant No. 3, northwest of Bakersfield, $1,985,000; to construct third unit in Big Creek, complete Shaver tunnel and reservoir, and Pittman tunnel, all east of Fresno, $2,108,000; to complete substation at Richgrove, $814,000; to complete transmission line from Kern River No. 3 to Richgrove, $513,000; to complete work at Eagle Rock, increasing capacity of susbtation, $312,000; installation of steam turbine at Long Beach station, $120,000; construction of general transmission and distribution system, $2,535,000.

McFARLAND, CAL.—A committee has been appointed to establish a community power plant. George Carter and Carl Mechler have urged this movement.

PASADENA, CAL.—A proposition will be submitted to the voters on July 1, to issue bonds to the amount of $500,000 to purchase the local plant of the Southern California Edison Company.

PASADENA, CAL.—A proposal to construct a new electric railroad to Los Angeles by private parties, and later be taken over by the city, has been suggested to the City Commission by Horrace M. Dobbins.

PORT COSTA, CAL.—The installation of a new electrically operated tramway system is under consideration by the Port Costa Brick Works.

REDDING, CAL.—The Pacific Gas & Electric Company contemplates the erection of a 230,000-volt transmission line from its Pitt River plant in Shasta County to San Francisco.

SAN BERNARDINO, CAL.—Plans are being prepared for the installation of a direct-connected horizontal pump and motor to be used in connection with proposed reservoir for boosting water from city wells to the mains.

SAN PEDRO, CAL.—The first unit of construction work for the Fabri-Cord Tire Company, 917 Citizens' National Bank Building, Los Angeles, is the erection of a tire factory, to cost about $280,000, including equipment. The total cost of the construction work is estimated at about $2,000,000.

BRIGHAM CITY, UTAH. — A special election will be held soon for the purpose of submitting to the voters a proposition to issue $120,000 in bonds, to be used for rebuilding the municipal electric plant to develop a maximum of 1,500 hp. electrical energy.

Canada

VANCOUVER, B. C.—Permit has been taken out by the Dominion Canners, Ltd., for the construction of a power station, to cost about $13,500.

FREDERICTON, N. B. — Kenneth Rea, architect of Montreal, Que., has recommended an addition to the Victoria Hospital, including the installation of a power plant.

PETERBORO, ONT.—The erection of a new power transmission station is contemplated by the Peterboro Utilities Commission.

TORONTO, ONT.—The Muskoka Quarries of Toronto, recently incorporated, contemplates the erection of a plant near Bracebridge and the installation of electrically driven equipment. W. B. Tait, 271 Macpherson Avenue, Toronto, is president and general manager.

WOODSTOCK, ONT.—In connection with the construction of a substation on Ingersoll Avenue for the Water and Light Commission, to cost about $35,000, electrical equipment including switchboard apparatus, transformers, etc., will be required.

SHAWINIGAN FALLS, QUE.—Contract has been awarded to William I. Bishop, 822 New Birks Building, Montreal, by the Belgo-Canadian Pulp & Paper Company for the construction of a transformer house.

VERDUN, QUE.—Bids will be received until July 15, for extension to the civic electric plant, to cost about $38,000. A. Gyshon of Verdun is engineer.

WESTMOUNT, QUE.—J. A. Jarman, city engineer, will soon receive bids for the installation of fire and police signal systems, to cost about $10,000.

(Issued May 25, 1920)

1,340,935. TELEPHONE-EXCHANGE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed July 11, 1919. Improvements in testing circuit.

1,341,486. PROTECTIVE SYSTEM; Oliver C. Traver, Schenectady, N. Y. App. filed Oct. 17, 1919. For electric feeders of pilot-wire type.

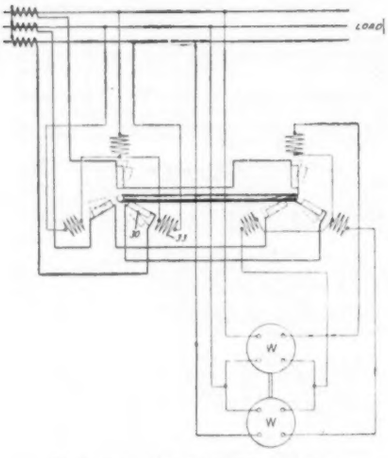
1,341,488. PROTECTIVE DEVICE; Edmund B. Wedmore, Hendon, Eng. App. filed Oct. 24, 1919. For feeders or plants of large magnitude.

1,341,492. ELECTRIC MACHINE; Pierre Bossu, Paris, France. App. filed Jan. 23, 1915. For lighting railway cars.

1,341,516. CHLORINE CELL; Thomas A. Patterson, Niagara Falls, N. Y. App. filed Feb. 17, 1920. To deliver pure chlorine.

1,341,558. MEANS TO BE EMPLOYED IN THE ELECTRIC WELDING OF IRON OR STEEL OR ALLOYS THEREOF; Augustus C. Hyde, Pervale, Eng. App. filed Nov. 25, 1919. Use of flux.

1,341,559. TRAINMAN'S KIT; George B. Jackson, Philadelphia, Pa. App. filed Aug. 19, 1919. Has electric lamp and colored lenses.



1,342,082. Volt-Ampere Meter

1,341,619. EXTERNAL IGNITION DEVICE FOR INTERNAL-COMBUSTION ENGINES; Herman Schlaich, Brooklyn, N. Y. App. filed Feb. 19, 1919. For lighting cigar, torch, etc.

1,341,626. PROCESS AND MACHINE FOR MAKING CERTAIN ARTICLES OF MANUFACTURE; Frank P. Kobert, Amityville, N. Y. App. filed Nov. 18, 1916. Heading, upsetting and forging machines with electric heater.

(Issued June 1, 1920)

1,341,629. ELECTRICAL RELAY; Harold W. Brown, Ithaca, N. Y. App. filed Jan. 7, 1914. Inverse-time overload trip.

1,341,647. ELECTRODE FOR SOLDERING AND DEPOSITING METALS BY THE ELECTRIC ARC; Ernest H. Jones, Islington, London, England. App. filed Aug. 16, 1919. Asbestos yarn wrapping securely attached.

1,341,650. MOTOR-CONTROL SYSTEM: Reese T. Kintzing, Wilkinsburg, Pa. App. filed Nov. 18, 1916. Prevents motor damage.

1,341,657. CONTROL SYSTEM: Frederick H. Miller, Wilkinsburg, Pa. App. filed March 2, 1917. For electric railway cars.

1,341,658. STARTER FOR INTERNAL-COMBUSTION ENGINES; John R. Millward, Newark, N. J. App. filed Nov. 19, 1913. Circuits interlock with gears.

1,341,659. ELECTRIC STARTER FOR INTERNAL-COMBUSTION ENGINES; John R. Millward, Newark, N. J. App. filed Nov. 19, 1913. Automatic coupling.

1,341,660. ELECTRIC STARTER FOR INTERNAL-COMBUSTION ENGINES; John R. Millward, Newark, N. J. App. filed Nov. 19, 1913. Automatic coupling.

1,341,675. CONTROL SYSTEM: Lynn G. Riley, Wilkinsburg, Pa. App. filed Oct. 30, 1916. For vehicles.

1,341,713. BATTERY PLATE; Otto P. Hoffman, Chicago, Ill. App. filed May 24, 1919. New design of strengthening ribs.

1,341,719. KEY SWITCH; Byron L. Moore, Buffalo, N. Y. App. filed Aug. 24, 1918. For telephone and radio.

Record of Electrical Patents

Notes on United States Patents

1,341,786. PROCESS OF RECOVERING COPPER FROM ITS ORES; Charles J. A. Dalziel, London, England. App. filed Sept. 24, 1918. Single continuous operation without filtration.

1,341,790. ELECTROCHEMICAL ANALYTICAL CONTROL; Philip E. Edelman, Minneapolis, Minn. App. filed Aug. 19, 1912. For unskilled operators.

1,341,801. GRADED-SERVICE ELECTROMECHANICAL TELEPHONE-EXCHANGE SYSTEM; Georg Heimann, Charlottenburg, Berlin, Germany. App. filed Aug. 28, 1913. Zone system.

1,341,808. METAL-WORKING MACHINE; Otto H. de Lapotterie, New Brighton, Pa. App. filed April 20, 1918. Electrical heating while upsetting, forging, etc.

1,341,810. TELEGRAPH KEY; William P. Liles, Marlow, Tenn. App. filed July 13, 1915. "Dead-man's" release.

1,341,855. ATTACHMENT FOR TELEPHONES; Sidney M. Knopf, New York, N. Y. App. filed May 2, 1918. Holds receiver.

1,341,878. TROLLEY-GUIDE BOX AND SHIELD; George W. Bolden, Philadelphia, Pa. App. filed Jan. 31, 1918. Box on trolley prevents leaving wire.

1,341,903. OVEN OR FURNACE; George M. Hollenback, Los Angeles, Cal. App. filed Feb. 7, 1920. For dental casting.

1,341,937. MOTOR CONTROLLER; Wilmer M. Shallcross, Milwaukee, Wis. App. filed March 21, 1914. Series-parallel drum controller.

1,341,939. PROCESS FOR PRODUCTION OF LOW-CARBON FERROCHROME; Hugh C. Sicard, Buffalo, N. Y. App. filed Sept. 26, 1919. Decarbonization of high-carbon ferro-chromium alloy by titanic oxide.

1,341,958. ELECTRIC SPEEDOMETER; Stover C. Winger and Adolph Rickenbacher, Los Angeles, Cal. App. filed Aug. 26, 1919. For indicating speed and mileage.

1,341,966. INCANDESCENT ELECTRIC LAMP; Shigezo Yuyama, New York, N. Y. App. filed Nov. 30, 1918. Increased vertical illumination.

1,341,994. CABINET; Olaf A. Nelson, San Francisco, Cal. App. filed March 13, 1919. Electric cooker heats when drawer is open.

1,341,997. TELEPHONE TRANSMITTER; Stephen C. Porter, Brooklyn, N. Y. App. filed April 22, 1918. Small, portable transmitter.

1,341,998. TELEGRAPH SYSTEM; Paul M. Rainey, West Hoboken, N. Y. App. filed Aug. 6, 1917. For printing system.

1,342,001. DRY CELL; Walter B. Schulte, Madison, Wis. App. filed Aug. 26, 1918. Improved terminals.

1,342,034. TROLLEY HANGER; Richard T. Todhunter, Barnesboro, Pa. App. filed March 6, 1919. Jaws tightened with conical screw.

1,342,049. SIGNAL DEVICE FOR AUTOMOBILES; Joseph Klipper, West New York, N. J. App. filed Feb. 20, 1919. Direction signal.

1,342,053. BUSHING-FORMING MACHINE; Oscar W. McKnight, Columbus, Ohio. App. filed Feb. 6, 1919. Makes porcelain bushings and tubes.

1,342,061. SWITCH AND CONTACT MECHANISM FOR ELECTRIC CURRENT-REGULATING PLUGS AND SOCKETS; Antonio Papini, Philadelphia, Pa. App. filed March 29, 1920. Key-switch mechanism.

1,342,068. ELECTRIC BATTERY; Otto E. Ruhoff, Madison, Wis. App. filed April 28, 1919. Material becomes active as it is consumed.

1,342,081. VOLT-AMPERE METER; Donald J. Angus, Indianapolis, Ind. App. filed Aug. 25, 1919. True measurement regardless of power factor.

1,342,082. VOLT-AMPERE METER; Donald J. Angus, Indianapolis, Ind. App. filed Aug. 25, 1919. True measurement regardless of power factor.

1,342,084. COMPOSITION OF MATTER AND METHOD FOR PRODUCING THE SAME; Louis E. Barton, Niagara Falls, N. Y. App. filed Sept. 4, 1919. For zirconium oxide concentrates.

1,342,111. LIGHTNING ARRESTER; Charles W. Howe, Healdton, Okla. App. filed Sept. 19, 1918. For protecting oil tanks.

1,342,179. COOLING ARRANGEMENT FOR DYNAMO-ELECTRIC MACHINES; Paul A. H. Mossay and Henry C. E. Jacoby, London, England. App. filed April 19, 1918. Air channels in yoke.

1,342,199. IMPULSE STARTER; Frederick W. Andrew, Brooklyn, N. Y. App. filed Nov. 18, 1918. For engine magneto.

1,342,209. ELECTRICAL COIL; Thomas P. Giblin, Pawtucket, R. I. App. filed Nov. 12, 1919. Inductance coils for tuning circuits.

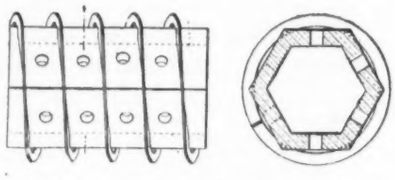
1,342,219. SAFETY SWITCH MECHANISM; Hubert F. Krantz, Brooklyn, N. Y. App. filed June 6, 1918. Prevents opening main switch when branch switch is "on."

1,342,241. SEMI-AUTOMATIC TELEPHONE SYSTEM; John Wicks, Chicago, Ill. App. filed March 21, 1918. Busy line automatically connected when it becomes idle.

1,342,242. TELEPHONE-EXCHANGE TRUNKING SYSTEM; Bernard D. Willis, Chicago, Ill. App. filed June 10, 1909. Connecting manual to automatic exchange.

1,342,250. TRANSFORMER; Vannevar Bush, Medford, Mass. App. filed May 5, 1917. Variable radio-transformer.

1,342,257. ELECTROMAGNETIC-WAVE NAVIGATIONAL SYSTEM; James Erskine-Murray and James Robinson, Biggin Hill, England. App. filed Dec. 16, 1919. Determines direction of radio waves.



1,342,310. Insulated Support for Electrical Conductors

1,342,260. TOLL TELEPHONE SWITCHING APPARATUS; Herbert M. Friendly and Archibald E. Burns, Portland, Ore. App. filed June 15, 1915. Remote control of switching.

1,342,303. INSULATED SUPPORT FOR INDUCTANCE COILS; Louis Steinberger and Guy Hill, Brooklyn, N. Y. App. filed Aug. 9, 1917. Allows free air circulation.

1,342,305. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger and Guy Hill, Brooklyn, N. Y. App. filed Nov. 15, 1917. For radio coils.

1,342,306. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger and Guy Hill, Brooklyn, N. Y. App. filed Jan. 17, 1918. For radio coils.

1,342,307. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger and Guy Hill, Brooklyn, N. Y. App. filed May 18, 1918. For radio coils.

1,342,308. INSULATED SUPPORT FOR INDUCTANCE COILS; Louis Steinberger and Guy Hill, Brooklyn, N. Y. App. filed Aug. 9, 1917. For radio coils.

1,342,309. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger and Guy Hill, Brooklyn, N. Y. App. filed Nov. 15, 1917. For radio coils.

1,342,310. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger, Brooklyn, N. Y. App. filed Feb. 1, 1919. For radio coils.

1,342,311. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger, Brooklyn, N. Y. App. filed Feb. 1, 1919. For radio coils.

1,342,312. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger, Brooklyn, N. Y. App. filed Sept. 24, 1919. For radio coils.

1,342,322. FLASHLIGHT; Frank D. Boulanger, West Hoboken, N. J. App. filed Oct. 14, 1919. Opens at side.

1,342,336. ELECTROLYTIC CELL; Paul McDorman, Niagara Falls, N. Y. App. filed June 19, 1919. Gas-tight container.

1,342,394. STREET INDICATOR; S. Denver Roberson, St. Louis, Mo. App. filed Aug. 26, 1919. Notifies occupants of car name of street.

Vol. 75, No. 26 New York, June 26, 1920 *Pages* 1463-1518

Electrical World

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W. H. ONKEN, JR., *Editor*

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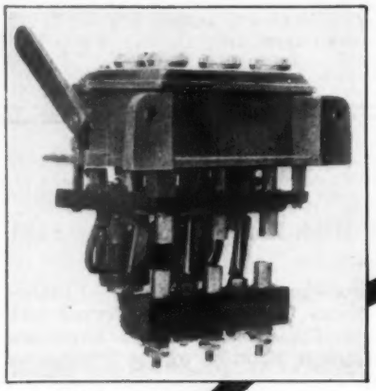
THE ELECTRICAL TRIO:
JOURNAL OF ELECTRICITY —— ELECTRICAL WORLD —— ELECTRICAL MERCHANDISING

Circulation of this issue, 27,150

For Industrial Service



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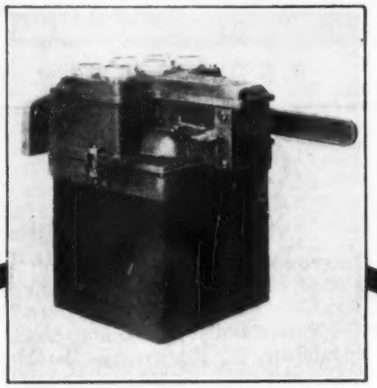

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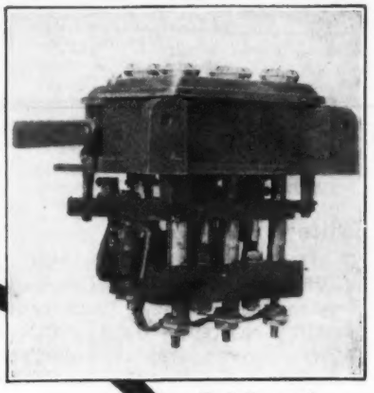

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A simple but reliable low priced, Oil Circuit Breaker of considerable interrupting capacity, for use on Industrial Circuits.

These breakers are used on branch feeders for automatic control, and protection against heavy overloads and short circuits, in connection with other motor starting devices.

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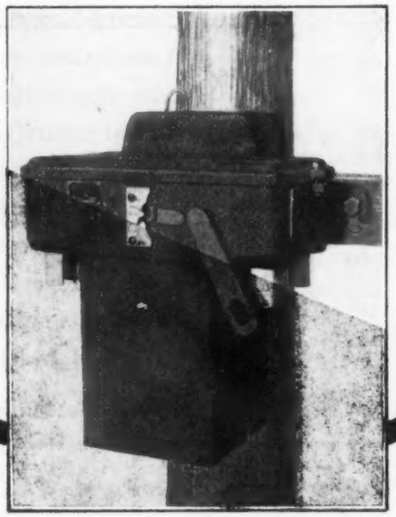
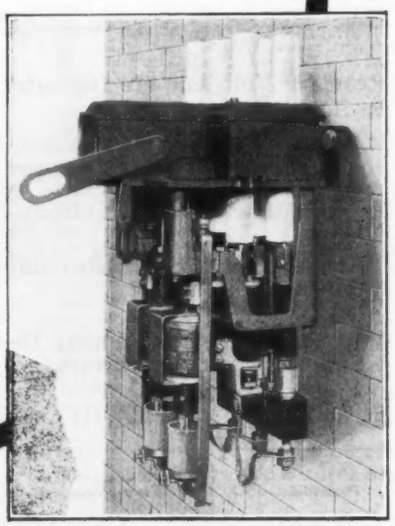


Three-Pole, Weatherproof, Outdoor Mounting Type H Oil Circuit Breaker, Undervoltage and Full Automatic Overload Trip, with Adjustable Inverse Time Element.



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QUALITY PRODUCTS

ON page 6 of the June 3rd issue of "Printer's Ink," a publication well known for the excellence of its merchandising articles, the following statement is made:—

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This is additional confirmation of the value of handling the complete line of Western Electric Quality Products—a line that includes practically every kind of electrical appliance for the home, as well as electrical supplies and equipment for every purpose.

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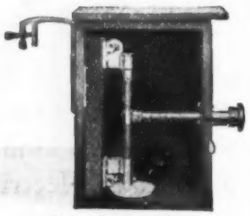
Operation

Door Open
Contacts Closed



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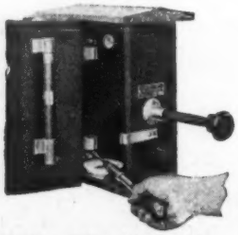
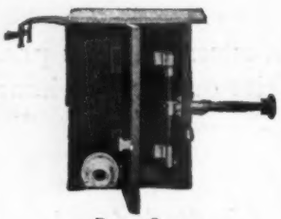


Door Open, Showing
Access to Connection



Door Open
Contacts Open

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FISHER-CHASE
Primary Current
Fuse & Disconnecting Switch

low cost, high degree protection for primary lines and transformers.

Anaconda's Rod and Wire Mill, located on the Missouri River, close to one of the greatest natural water power sites in the country, is equipped with the most up to date machinery obtainable to manufacture all commercial sizes of hot rolled copper rods, bare copper wires, cables and trolley wires, out of Anaconda Electrolytic copper of 100.75% conductivity. Matthiessen's Standard.

ANACONDA COPPER MINING COMPANY
Rolling Mills Department
Mills—Great Falls, Montana
General Offices—111 W. Washington St., Chicago

Trolley Wire Drawing Bench at the Anaconda Mills

ANACONDA Copper Wire
"From Ore to Finished Product"

MANTRA

When a Hindu reaches a certain age he gets the sacred triple cord to wear and his teacher gives him a secret word or mantra that he must always remember. The repetition of this mantra in time of need produces wonderful results.

Now it's a pretty good idea to have a sign and mantra to buoy us up now and then. That is why we give to operators the TRIPLE LINK as a sign and MORGANITE as a mantra to turn to when commutation is topsy turvy.

And if **Morganite** is a good name for operators to remember, then we should make good use of it ourselves—

—therefore—the name of the Morgan Crucible Company from now on will be

Morganite Brush Co., Inc.

Main Office and Factory: 519 West 38th St., New York

DISTRICT AGENTS:

Lewis & Roth, 13th and Wood Sts., Philadelphia
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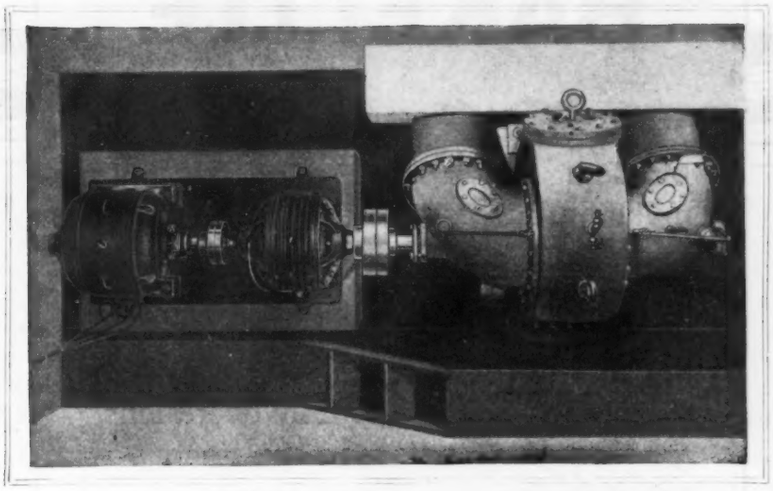


In those "out-of-the-way" places you can count on Turbo-Gear

For three years this Turbo-Gear has been driving a 24-inch drainage pump in a large Southern cement plant.

It reduces the 1140 R. P. M. of the fifty-hp. motor to 400 R. P. M. in the drainage pump—

And in these three years it hasn't cost a cent in upkeep—

It hasn't lost a minute—

"Why?"

Because it's made on the right principles—"straight line" drive, no offset shafts (see illustration), no side strain on shafts or bearings—no noise—no vibration. Turbo-Gear is also ideal for driving other auxiliaries such as fans, stokers, blowers, etc., whether the speed is to be reduced or accelerated.

Have you our latest bulletin?

TURBO GEAR
FAST PATENTS

The Poole Engineering & Machine Company

Baltimore, Maryland

BOSTON 638 Old South Bldg. | CHICAGO 457 Peoples Gas Bldg. | CLEVELAND 710 Engineers Bldg. | PITTSBURGH 781 Union Arcade | NEW YORK 50 Church Street

We also manufacture — Fertilizer Mixers, White Lead Mills, Automobile Parts, Grey Iron Castings, Semi-Steel Castings, Special Machinery, Machine Moulded Gears

BAKELITE

REG. U.S. PAT. OFF.

—saves assembling operations.

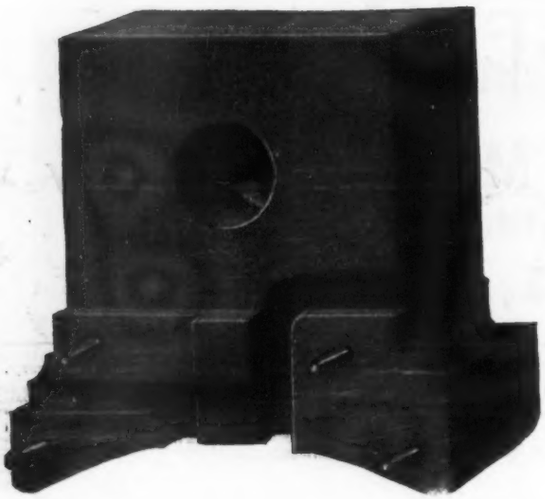
Moulding with **BAKELITE** not only makes unnecessary the usual trimming and buffing of small moulded pieces—because **BAKELITE** takes such a clean, sharp impression and lustrous finish from the mould—but it also saves subsequent assembly operations, *for metal inserts can be incorporated in the moulding process.*

Since **BAKELITE** does not shrink, swell or warp after moulding, there is no question as to the correct position of any insert—which saves scrapping valuable work and increases hourly production.

GENERAL BAKELITE COMPANY

Two RECTOR STREET

NEW YORK



The accurate and secure placing of the four pins, the irregular channel and the exactly centered hole were all done in the moulding.

Dear Boss:

The coal is in the cellar — along with other valuables.

— And it was all put in long before it was needed.

— and it was all bought so far in advance that there was no question as to getting it.

Now when I come in on the 7:15 next winter and the general topic is bawling out the coal dealer, the coal trust, etc., because everyone is on his last shovelful —

— then boss — I'll laff and say "Boys these be times when our best people are not accumulating stock for telegraphic shipments; when railroads are not running empty cars and waiting engines up to the backdoor of the plant to drum up business.

"These be times when you've got to wait the normal manufacturing time on anything you buy.

"Even with Nichrome which is made by the busiest bunch of wholehearted workers in America — it takes 12 weeks from lab analysis of materials to lab test of finished Nichrome.

"And that time can't be beaten without beating the public eventually.

"I've seen mfrs. get into jams because they didn't take note of that and keep their eyes and requisitions three months ahead.

"But now that they're doing it things look brighter

"Order the winter's supply now."

Nyl Chrome

DRIVER-HARRIS COMPANY

HARRISON, N.J.

CANADIAN WORKS
CANADIAN DRIVER-HARRIS CO.
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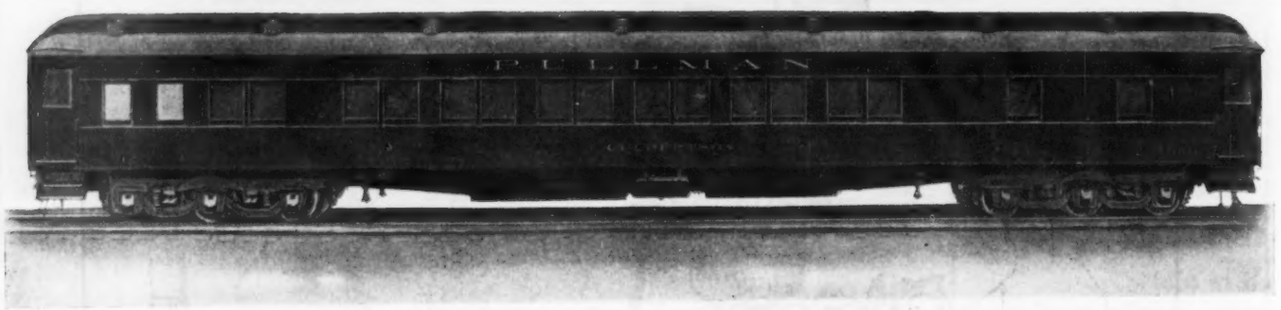
DRIVER, DRENNAN & COOPER
MANCHESTER, ENGLAND



Why?

WHY is the lighting system of *all* Pullman Cars equipped with Sangamo Meters?

WHY?

SANGAMO

Sangamo Electric Company

Springfield, Illinois

Specialists in Meters for Every Electrical Need

2060

"Noark" renewable and non-renewable cartridge enclosed fuses, in all standard capacities, are approved by the Underwriters' Laboratories, Inc., under the label service.

Motor Savers

WITH the cost of motors today there's more need than ever for a dependable fuse.

A "Noark" Fuse is a motor saver, carrying full rated load, but opening the circuit instantly, quietly and effectively under overload or short circuit.

"Noark" Fuses and all other Johns-Manville packaged Electrical Materials are distributed strictly through distributor-dealer channels on a basis that gives full protection to all concerned. Dealers can get all details from their distributor. Distributors, for samples and complete information, should apply to the Electrical Department of the nearest Johns-Manville Branch.

Manufactured by the Johns-Pratt Co., Hartford, Conn.
H. W. Johns-Manville Co., Sole Selling Agents

H. W. JOHNS-MANVILLE CO., Madison Ave. at 41st St., New York City
10 Factories—Branches in 64 Large Cities
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JOHNS-MANVILLE SERVICE
COVERS THIS CONTINENT

Through—

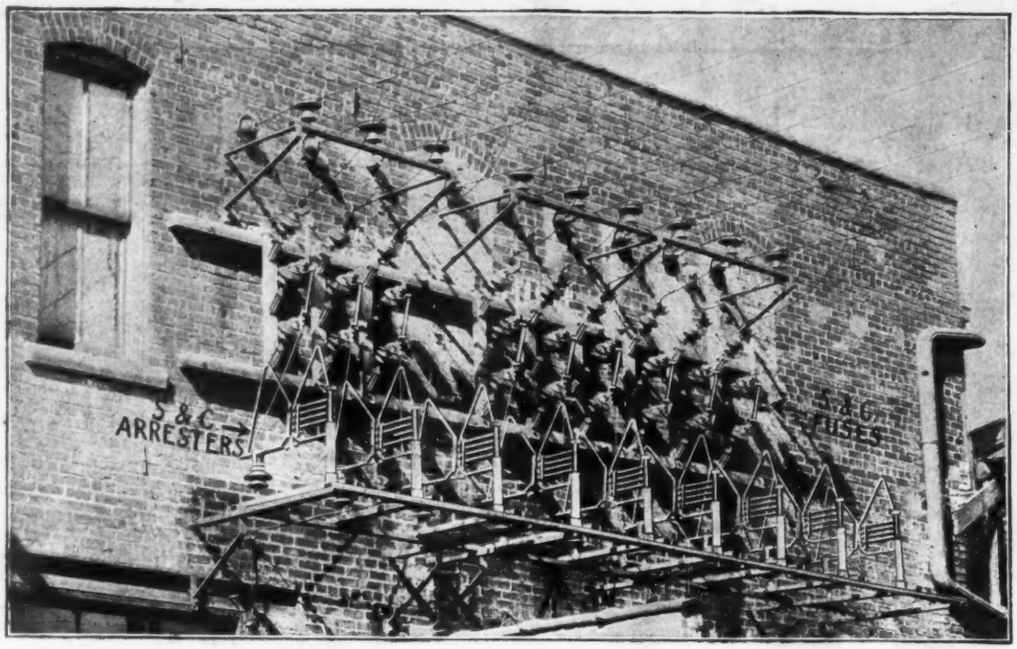
Asbestos

and its allied products

JOHNS-MANVILLE
Serves in Conservation

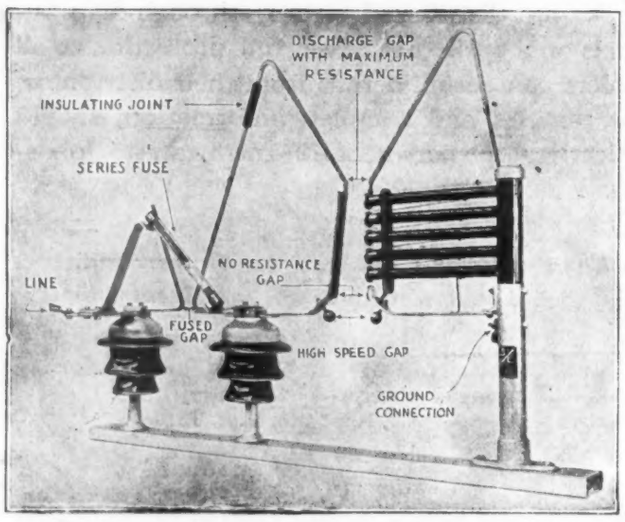
Heat Insulations, High Temperature Cements, Asbestos Roofings, Packings, Brake Linings, Fire Prevention Products

JOHNS-MANVILLE
ELECTRICAL MATERIALS



Type H, Form 1 Arresters with Series Fuses on Separate Mountings
12,000 Volt Installation.

S & C ARRESTERS



Form 3A —25,000 Volt Type H Arrester.

Type H, Form 3A Arresters with combined auxiliary gap and series fuse are designed for systems with large generating capacity. These arresters afford protection from lightning EVEN THOUGH THE SERIES FUSE HAS BLOWN.

Form 3A Arresters and Form 1 Arresters, without series fuse or in connection with independent fuse mountings, both operate with the effective valve action characteristic of S & C High Speed Graded Resistance Arresters.

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which should be in your library,
on request.

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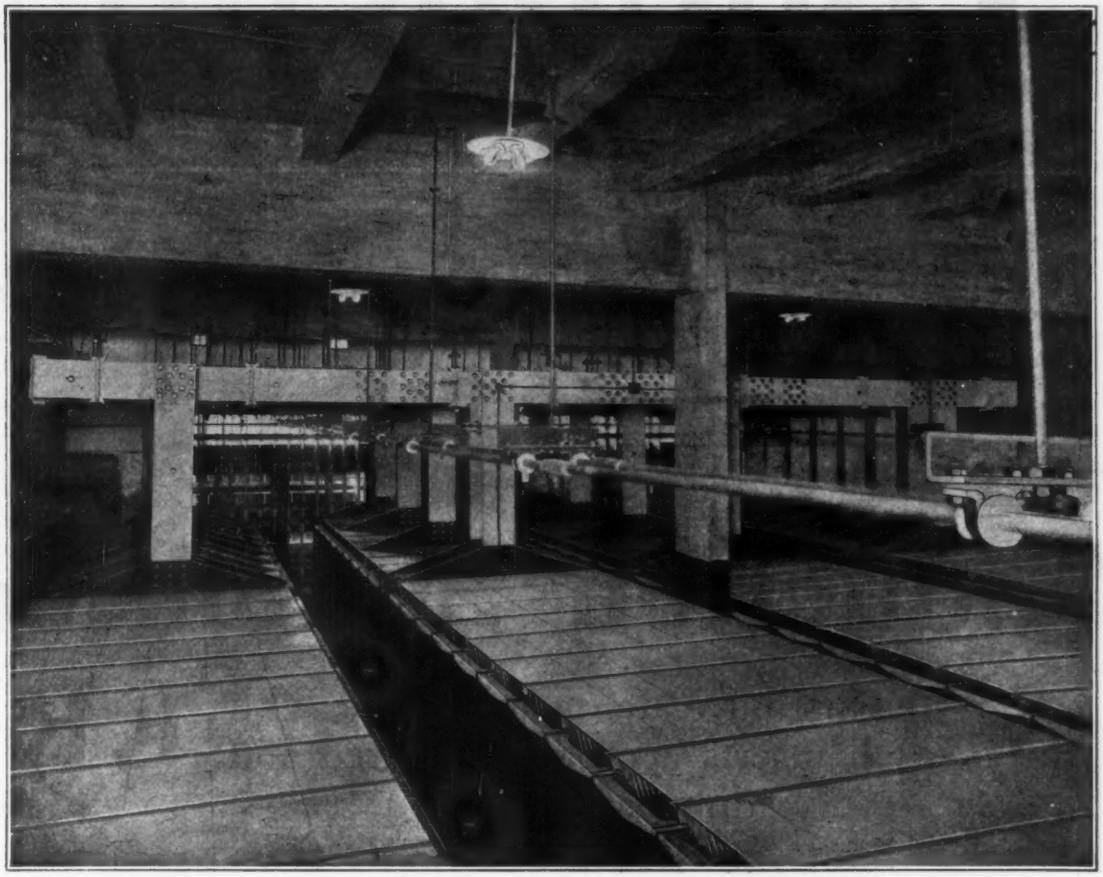
4435 RAVENSWOOD AVENUE CHICAGO, ILLINOIS U.S.A.

THE ELECTRIC STORAGE BATTERY CO.



A TYPICAL STAND-BY INSTALLATION MADE BY THIS COMPANY

In the early application of the storage battery to central station service the primary object sought was the improvement of the daily load factor of the steam plant by discharging the battery on the evening peak and recharging it during the hours of the lighter load.

Developments, however, soon exhibited the advantage of the battery as a reservoir of energy always ready for instant use in case of sudden and unexpected demand or failure of the normal source of power.

And it was for such an application that the first "Exide" stand-by battery was installed in the service of the New York Edison Company in 1908.

So well was it suited to the work required that since that time "Exide" has been the choice for practically every large central station installation in the United States

THE ELECTRIC STORAGE BATTERY CO.

The largest manufacturer of Storage Batteries in the world

1888 PHILADELPHIA, PA. 1920

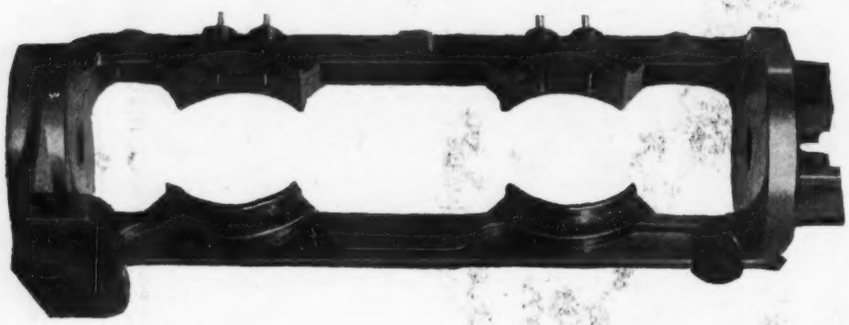
New York Boston Chicago Washington Denver San Francisco St. Louis
Minneapolis Cleveland Atlanta Kansas City Pittsburgh Detroit Rochester

Special Canadian Representatives, Chas. E. Goad Engineering Co., Limited, Toronto and Montreal

Batteries are made by this Company for every storage battery purpose

THE ELECTRIC STORAGE BATTERY CO.

Condensite



Production Simplified

This intricate meter frame, with all inserts accurately located and every dimension held to close limits, is molded in one operation from Condensite.

Condensite will simplify your molded insulation production problems whether they call for a simple terminal stud or some piece of unusual design.

We invite manufacturers to avail themselves of our engineering service.

Write for Booklets 5 and 6.

Condensite Company of America

Bloomfield, New Jersey

"Unilets"

—for rectangular base push switches

Type "FSP" Unilet Complete

THE Type "FSP" Series of Unilets have been designed to provide absolute protection for push button switches against atmospheric conditions, etc. Furnished with lapped cover and gasket, making installation weather-proof. Operating handle is plainly marked to indicate whether on or off. Furnished with black enamel or hot galvanized finish.

Drawn cold from steel; that's the reason for the strength and light weight of Unilets. Their construction provides more wiring space than the average fitting, which makes installation a quick and easy job.

Unilets are furnished in a wide range of sizes and designs in Black Enamel or Hot Galvanized finish. They are fully described in our latest illustrated catalog, a copy of which will be mailed free on request. Write today, specifying desk or pocket size edition.

Unilets are used extensively in the plant of the B. F. Goodrich Co., at Akron, Ohio.

Appleton Products Include

"Unilets," Outlet Boxes and Covers, Laundry Fittings, Locknuts and Bushings, Meter Terminal Fittings, Entrance Fittings, "Pagrip" Metal Molding and Fittings, Conduit Clamps and Hangers also Switch Boxes.

APPLETON ELECTRIC COMPANY

228 N. Jefferson St., Chicago

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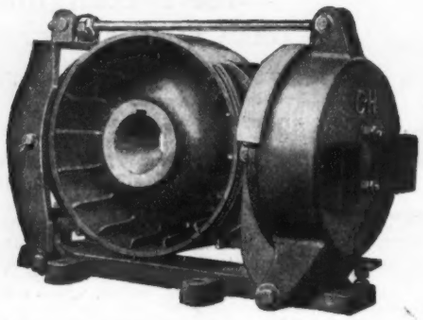
C-H

Where Are *You* Using C-H Type M Brakes?

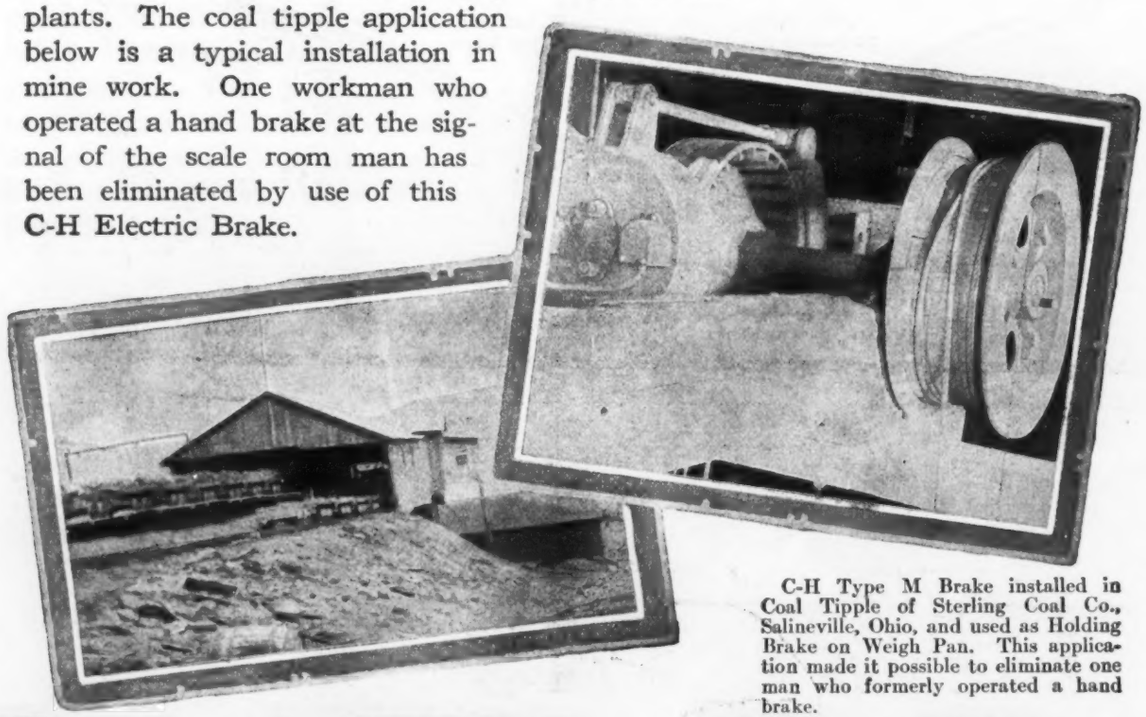


The Latest Design of C-H Type M Brake

Hundreds are being used in all kinds of hoists, cranes, and elevators —in mines, steel mills, and other industrial plants.

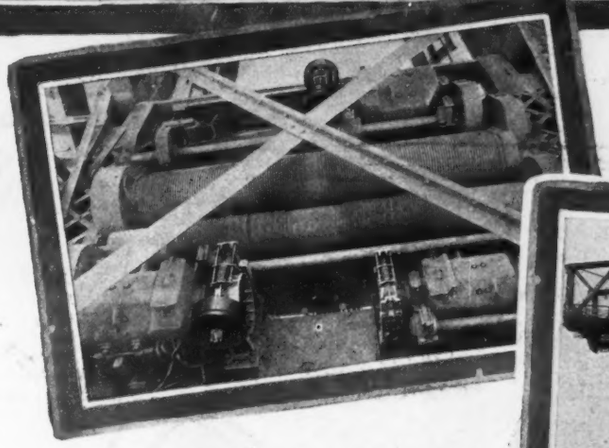
The small amount of space required, and the ease of adjustment make them the choice as standard in hundreds of plants. The coal tipple application below is a typical installation in mine work. One workman who operated a hand brake at the signal of the scale room man has been eliminated by use of this C-H Electric Brake.

The overall height is only a trifle over the brake wheel since the latest design has the magnet armature built as an integral part of the arms carrying the brake shoes. Capacities from 1 to 300 H. P. are made in sizes from 8-inch to 30-inch.

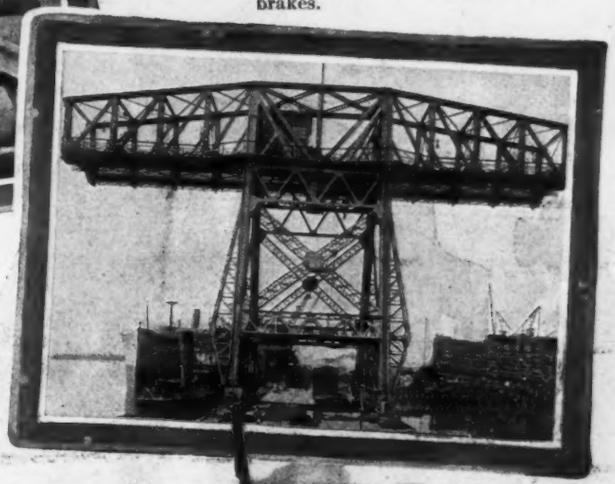


C-H Type M Brake installed in Coal Tipple of Sterling Coal Co., Salineville, Ohio, and used as Holding Brake on Weigh Pan. This application made it possible to eliminate one man who formerly operated a hand brake.

CUTLER-



The boom motor is 35 H. P. with a 14-inch brake. The winding drum motor is equipped with a second brake, and the third is a modified type operated by a lever from the crane cab and is used with a 5 H. P. motor operating the "swing."



The 150,000 pound gantry crane at the Newark Shipyard has all its motors equipped with C-H type of brakes.

156 On One Boom Hoist Job

All the motors on the huge 75-ton gantry crane at the Newark Bay shipyard of the Submarine Boat Corporation, are equipped with C-H Type M Brakes. On every one of the 56 Boom hoists on the 28 shipways of this yard there are three C-H Brakes of this type.

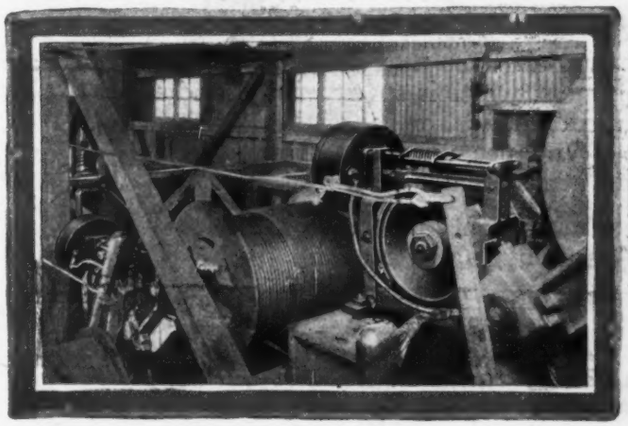
New Booklet

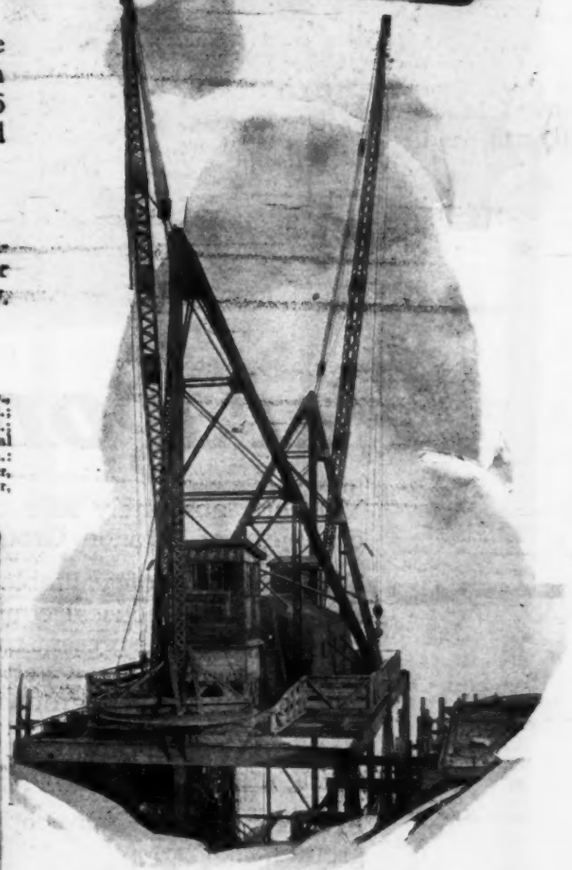
Publication 850, giving complete description, illustrations, methods of application and other data, is ready for distribution. Any district office will send you a copy.

THE CUTLER-HAMMER MFG. CO.
WORKS: MILWAUKEE AND NEW YORK

District Offices: New York: Hudson Terminal Bldg. (50 Church St.); Chicago: 323 No. Michigan Ave.; Pittsburgh: Farmers' Bank Bldg.; Boston: 77 Franklin St.; Philadelphia: Commonwealth Bldg.; Cleveland: Guardian Bldg.; Cincinnati: Gwynne Bldg.; Detroit: 905 Kresge Bldg.

Selling Agents: H. B. Squires Co., San Francisco: 583 Howard St.; Los Angeles: 206 So. San Pedro St.; Seattle: 552 First Ave. So.; General Machinery Co., Birmingham, Ala.: Brown-Marx Bldg.; H. L. Vaughan, Denver, 4710 Glenarm St.; L. Brandenburger, Salt Lake City, 59 West Broadway.





At the Newark shipyard of the Submarine Boat Corporation all of the 56 Boom Hoists on the 28 shipways are equipped with C-H Brakes—168 in all. These are used with the boom, winding drum and swing motors.

HAMMER

Paragon Grounds

You are absolutely sure of the efficiency, dependability and durability of Paragon Grounds. They have been fully tested.

The protection of valuable human lives that may be exposed and of your electrical equipment which is so expensive and so hard to get at the present time, demands the use of the very best grounds that you can get. Why use uncertain grounds when you can get the best grounds at no greater cost.

Paragon Grounds are made of pure continuous copper—guaranteeing maximum efficiency, durability and dependability.

Five feet of No. 4 pure copper connecting wire welded to every ground.

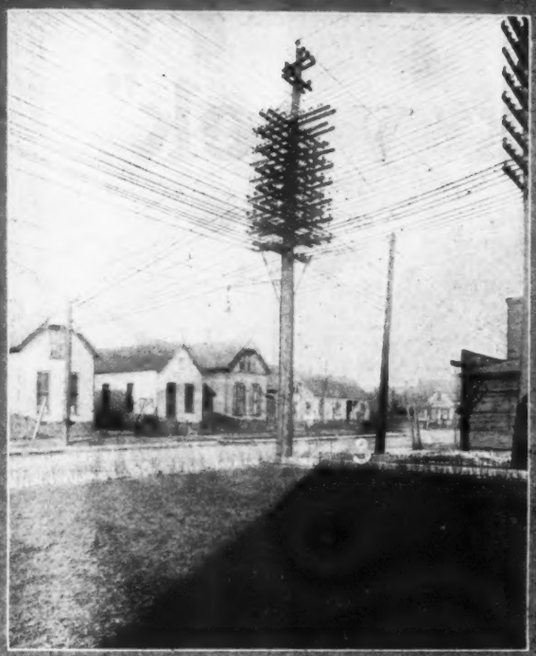
Our New Book on "Grounding Facts," furnished free on application with latest up-to-date information on grounding

Paragon Electric Co.

Dearborn and Van Buren Sts., Chicago, Ill.

911 Western Ave., Seattle, Wash. 86 Third St., San Francisco, Calif.
Northern Electric Company, Ltd., Canadian Distributors.

Cut Maintenance Costs by having Northern White Cedar Poles



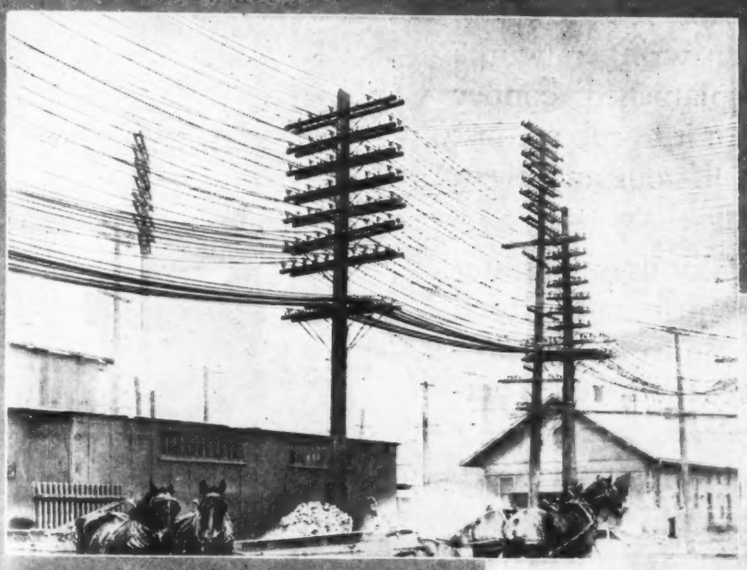
The nation over, Northern White Cedar Poles have proved to be the basis for economy in pole line construction.

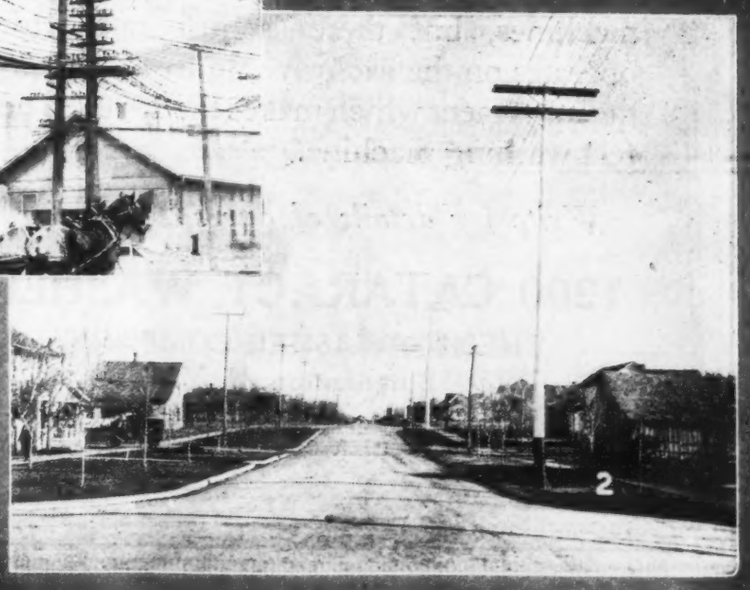
They are light, easily handled and transported, reducing labor costs.

Their strength eliminates loss by breakage.

Their long life spells minimum per annum cost.

The lines shown below are carried at a minimum per annum cost on Northern White Cedar Poles.





No. 1. Shows Northern White Cedar Poles in lines of the Columbus Railway, Power & Light Co. at Columbus, Ohio.

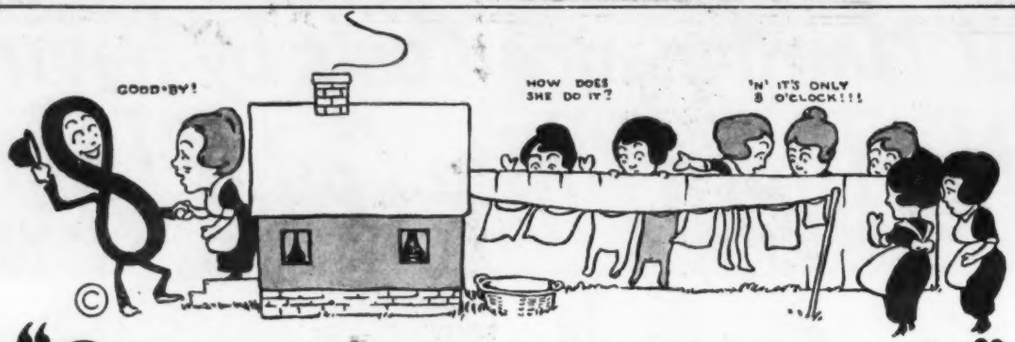
No. 2. Shows Northern White Cedar Poles in lines of the Empire Gas & Fuel Co. at Bartlesville, Oklahoma.

No. 3. Gives a lead in the lines at Evansville, Indiana.

No. 4. Shows a Northern White Cedar Pole Line in Dallas, Texas.

For further data write

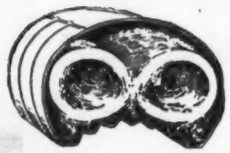
Northern White Cedar Association
Lumber Exchange, Minneapolis



"See you next week"

THAT'S the way with the 1900 Cataract Washer and its magic figure 8 movement. Everybody wants to see it this week, next week and every week!

For it's that figure 8 that makes the 1900 the perfect washing machine. By means of it, the water is forced through the clothes in a figure 8 movement four times as often as in the ordinary washer. Thus it washes the clothes faster.



The water swirls through the tub in a figure 8 movement four times as often as in the ordinary washer.

There are other superior features, too. The swinging reversible wringer works electrically. And the planished copper tub has not a single part in it to rub against the clothes. Nothing to lift out and clean when the wash is finished.

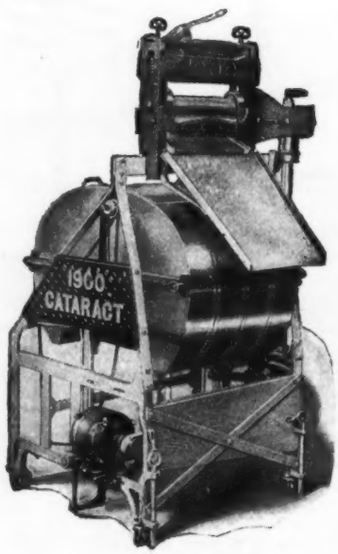
In short, there are many kinds of washing machines, but there is just one which operates on the exclusive figure 8 motion—the movement which makes the 1900 the perfect washing machine.

Write for details of our special offer.

1900 CATARACT WASHER

THE 1900 WASHER COMPANY
Binghamton, N. Y.

Canadian Factory and Office:
CANADIAN 1900 WASHER CO., 357 Yonge Street, Toronto



Comes in 8 and 12 sheet sizes.

Good, Reliable Service

Fine clothes make a good appearance, but it is the quality of material within a man that determines his reliability.

The neat appearance of the G-R-S Electric Clothes Washer may be a selling factor, but it is the absolute dependability of the operating parts within that assures permanent satisfaction to your patrons and minimizes the service cost.

The "G-R-S" is a thoroughbred among washing machines, made so by the quality of the material used and the nicety and accuracy of the design.

It will be sold through the Better Shops into the Better American Homes. Its construction by you will increase your reputation for

GOOD, RELIABLE SERVICE

GENERAL RAILWAY SIGNAL COMPANY

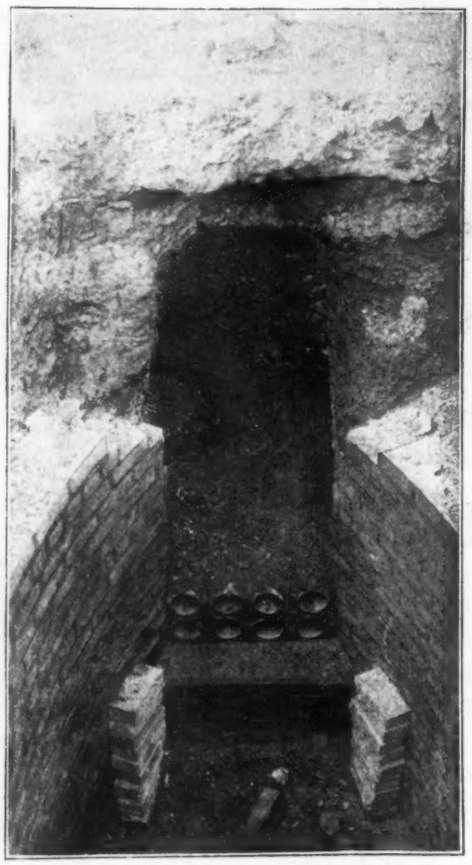
ROCHESTER, N. Y.

New York Chicago Montreal London Sydney

ORANGEBURG FIBRE CONDUIT

THE FIBRE CONDUIT CO. · REG. U.S. · ORANGEBURG · PAT. OFF · ORANGERURG N.Y.

Go Under with ORANGEBURG



and you will be assured of 100 per cent protection for your cables.

Orangeburg is the original fibre conduit. It is free, both inside and out, from burns or blisters of any description and the joints are sufficiently tight to eliminate seepage of concrete so that your cables can be pulled easily and without danger of damage.

The tight joints of Orangeburg, the ease and rapidity with which it can be installed make it an investment, not an expense.

THE FIBRE CONDUIT COMPANY

Orangeburg, N. Y.

New York Boston Chicago San Francisco

HUBBELL

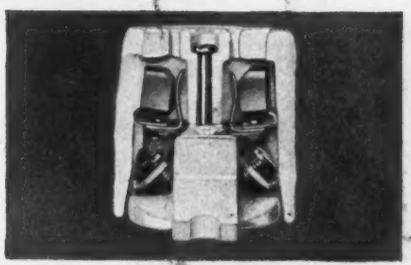
"Standard Superiority"

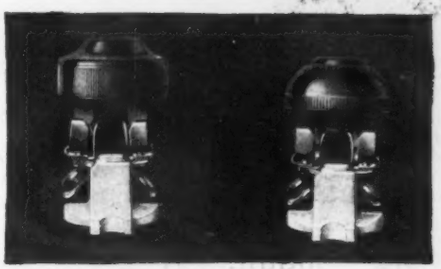
Steady improvement, *without departure from standard design,* has been the Hubbell accomplishment. In the manufacture of Attachment Plugs and Receptacles, each step forward has tended to widen rather than restrict their interchangeability.

The (patented) Double T-slots permit the use of standard caps with either tandem or parallel blades, yet exclude the fingers of the smallest child.

Phosphor bronze contact springs grip *both sides* of each blade, insuring a firm, even contact. They are so designed that parallel and tandem blades are equally secure.

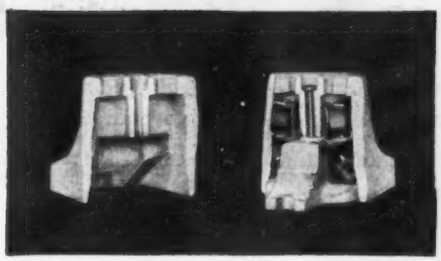
Individual arcing chambers prevent short circuiting.

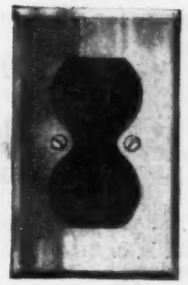




These improvements are embodied in all Hubbell Flush Receptacles for lighting circuits. In single outlet, "Duplex" and hinged-cover types, this common sense design combines with their pleasing appearance to insure your permanent satisfaction.

And the QUALITY? HUBBELL! Ask your jobber—or us.





Single Outlet Flush Receptacle No. 5547.

"DUPLEX" Flush Receptacle No. 6257.

Flush Receptacle No. 5579 for Plate with Hinged Cover.

Flush Receptacle No. 6282 with Small Round Plate.

2085-U

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Volts 44,000

Pipe frame
or
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Endurance is built into them

If you could but chat with the operating engineer of a Condit equipped station you would quickly catch that feeling of confidence so often shown by the man who operates our equipment.

And reflected in this expression of confidence is the endurance of the equipment resulting in minimum trouble and minimum maintenance.

Type D-15 Oil Switches and Circuit Breakers are built to give a dollar's worth of service for every dollar invested.

D-15 is made for either manual direct, manual remote or electrical remote control.

It will pay you to read Bulletin No. 426.

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CONDIT: the Synonym of Safety in Electrical Protective Equipment

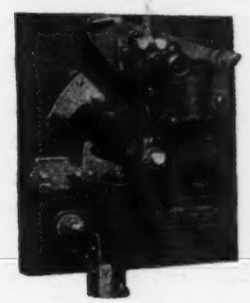
Ward Leonard Circuit Breakers Used on These Battery Charging Panels in Ford Motor Co. Plant, Detroit.

WARD LEONARD VITROHM
VITREOUS ENAMELLED RESISTOR UNIT
8000 Ohms

Ward Leonard Circuit Breaker

Ward Leonard Circuit Breaker—Switch Closed.

Ward Leonard Circuit Breaker—Reverse Current Switch Open.



Ward Leonard Circuit Breaker—Overload Switch Open.

The Ward Leonard Circuit Breaker is the dependable protection, in battery charging circuits, against overloads and over discharge of batteries.

The Ward Leonard Circuit Breaker is made up of two switches, one with a reverse-current trip and the other with an overload trip, and these two switches are connected in series in such a way as to give the same advantages as are obtained with double-pole circuit breakers, and yet provide for reverse current and no voltage in addition to overload protection.

These two switches are so interlocked that the overload switch must be closed first and cannot be closed when the reverse-current switch is closed. Therefore, if there is an overload on the circuit when the reverse-current switch is closed, the overload switch opens immediately, thus the circuit and the batteries and all apparatus connected thereto are completely protected even against careless and intentional misoperation.

Ward Leonard Circuit Breakers are used on all Ward Leonard Battery Charging Panels equipped with such protective devices. They are so designed as to form a practical adjunct to any battery charging panel. Let us tell you all about them and their use in battery charging stations.

Ward Leonard Electric Company

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D & W Standard Fuses 100% Protective

Look for the "D & W" Trademark— It Is Insurance Against Trouble

The fuses for any electrical installation is one of the essential features which is often given too little attention. Selection of the fuse best adapted to the demands of the circuit it is to protect, is an important matter if the best results are to be obtained.

In the design and manufacture of "D & W" Fuses every detail in the process is given careful attention. Uniformity and accuracy have always been distinctive features during a quarter of a century of fuse making.

When you consider the replacement value of the equipment on your circuits and compare it to the cost of protecting it with "D & W" Fuses you will appreciate the ultimate saving in buying 100% quality fuses.

Approved and Regularly Inspected by the Underwriters' Laboratories.

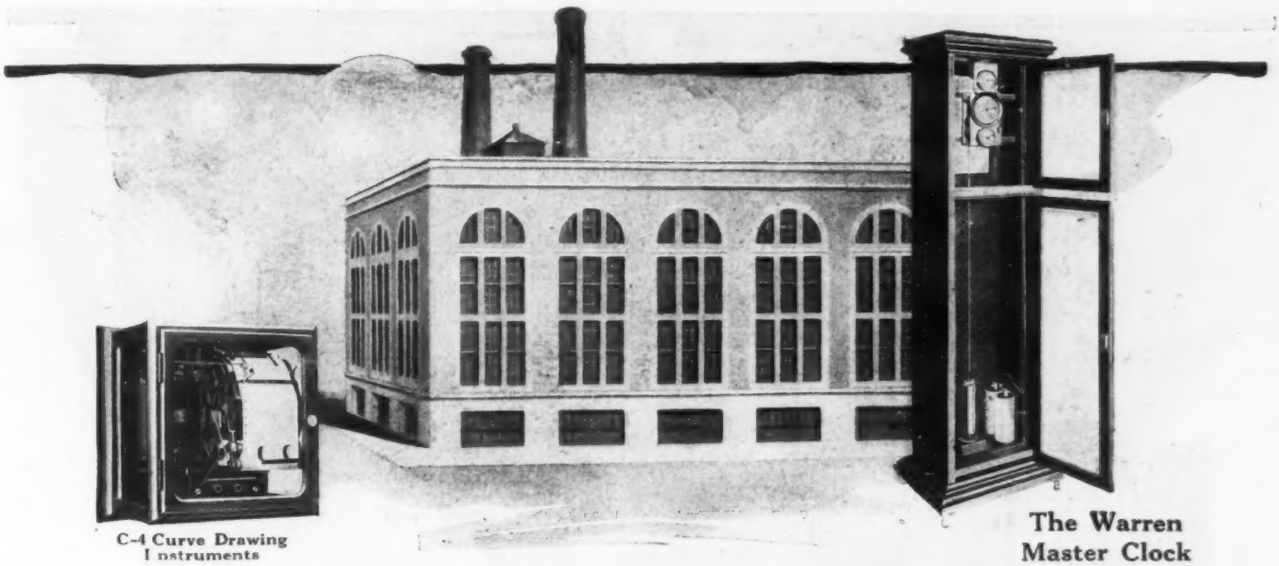
Fuse D&W Works

of General Electric Company

Providence, R. I.

DWF-17A

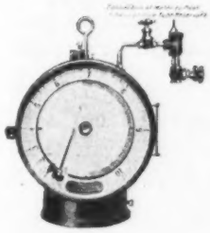
Your alternators if run at a constant average speed can perform the function of a timekeeping device.



C-4 Curve Drawing Instruments

G-2 and GS-2 Demand Meters

PS-2 Demand Meter



Flow Meter

A Warren Master Clock

in your generating station enables the operator to easily maintain the generator speed at a constant average value.

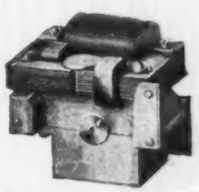
After establishing uniform average speed with the aid of this clock you can then use General Electric Graphic Instruments, Demand Meters, Flow Meters, etc., equipped with the Warren Synchronous Motor, instead of the familiar spring-driven clock, and from such instruments—

—obtain better timekeeping qualities,
—eliminate winding,
—obtain synchronized records,
—obviate much of the attention a spring-driven clock demands.

The Warren Master Clock

This device comprises a high-grade pendulum clock and a miniature self-starting synchronous motor. Each operates, independently, a hand on the dial of the master clock. When the frequency is correct, both hands move at the same rate. The operator simply adjusts speed so that the hands will always be together.

Drop our nearest office a line if you are interested and you will be sent descriptive bulletin.



Warren Synchronous Motor (¼ Size)

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

34B-7

There is no question about the advisability of installing Feeder Regulators on your growing lines, to save money and give a uniform voltage

Standard Station Type Feeder Voltage Regulator with Panel

Just like finding money

DO you fully realize what feeder voltage regulation means to you? It simply means you probably can extend or increase the capacity of your existing lines at a considerably lower cost including cost of regulator and greatly improve your service. You are not only reducing expenses, but are able to maintain a satisfactory voltage with but 1% variation at the center of distribution.

It has been proven by actual measurement that for every 1% drop in voltage the central station is losing 1½% in revenue.

In view of these known and proven facts is it not true that the economy derived from G-E Voltage Regulators is "*just like finding money*"?

General Electric Company

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B33-17

Where safety, artistic effect and efficiency are combined in a street lighting system true foresight in selection has been exercised.

Beauty and Economy Combined

St. Paul, Minn., wanted an up-to-date, handsome and efficient street lighting system. They chose the Form 12 Novalux Unit with I. L. Series Transformers.

For small town and metropolis, for residential and business sections—there are exactly the right Novalux street lighting units to provide scientifically correct illumination most economically.

For the protection of individual lamps, I. L. Series Transformers are mounted in the base of the standard. These transformers protect the lamp from surges in the line and permit each lamp to burn independently of the others in the circuit. They are particularly "Safety First" features insulating the pole and lamp from the high tension series circuit.

Embodied in the design of GE street lighting material is the broad experience of a company that makes everything from generator to lamp.

Our street lighting specialists will advise you impartially.

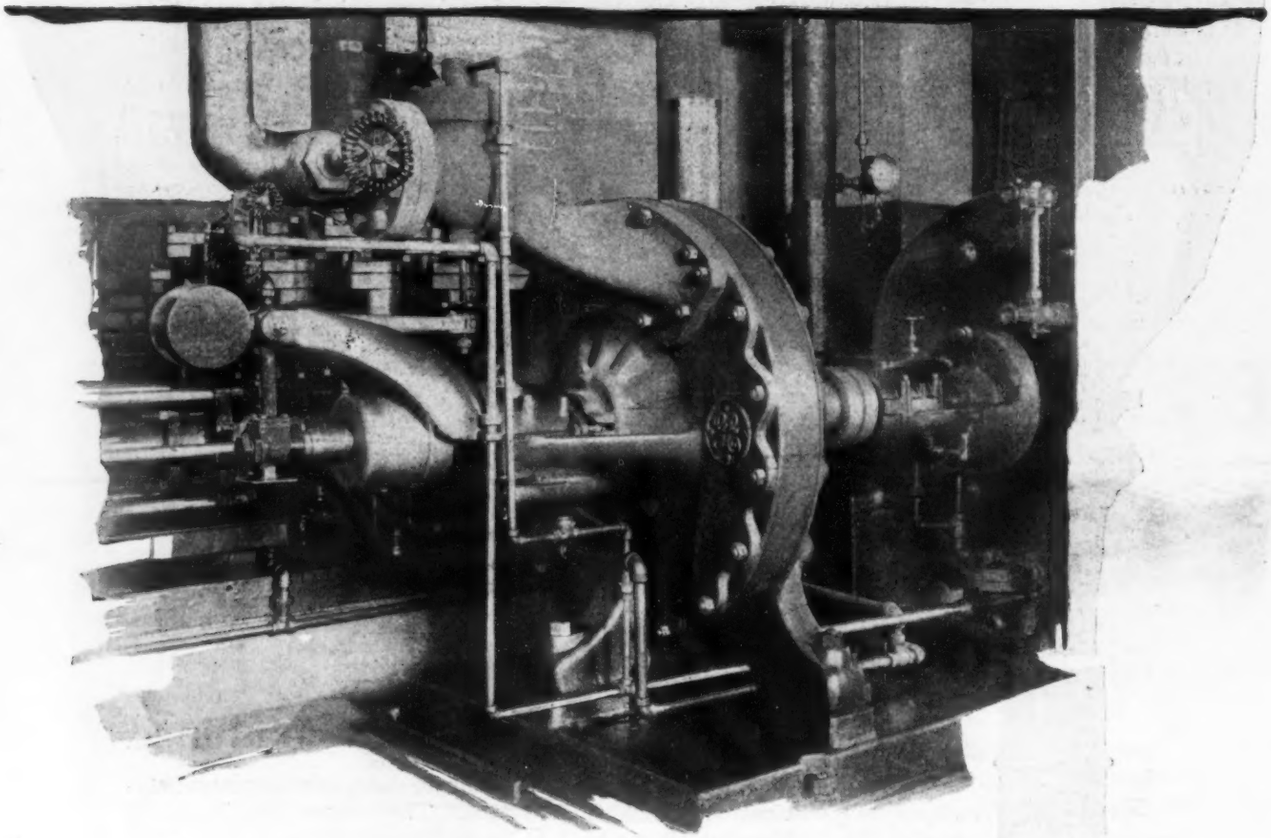
General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

350-20

The broad experience of this company in turbine design and manufacture has resulted in the production of the most reliable apparatus.



Type L Curtis Turbine Driving Centrifugal Pump

THIS type of turbine is manufactured in a wide variety of capacities to drive fans, blowers and centrifugal pumps.

Send for leaflets 82011-12 and 13 which give valuable information as to the construction of these turbines.

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

31-9

What makes a good motor? We say, "Correct design, good material, careful workmanship, plus rigid and repeated tests and inspections."

RC Direct Current Motors

½ to 200-horsepower.

Commercial Testing

WE show just a corner of one of our big motor buildings, where Type "RC" direct motors are being tested.

Motors are inspected for correct assembly and adjustment. Every motor is then belted to an individual generator and subjected to load.

During test careful checks are made to assure accurate brush setting and sparkless commutation, to guard against undue noise or vibration, to see that the lubricating system functions properly, and that rated speed is maintained.

Each motor is then given a "high potential" test, and finally, a rigid, general inspection before painting and shipping.

Our final "O.K." on scores of thousands of motors has to mean "just right," and it does.

45-56

General Electric Company

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AN INVESTMENT

When you put your money into KERITE you make an investment in service. You do more than buy conductors, insulation and protection. You obtain the best possible combination of the most desirable qualities in permanent form.

KERITE remains long after the price is forgotten.

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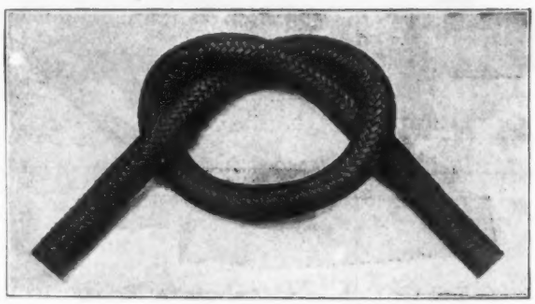
4

SIMPLEX HARD SERVICE CABLE

FOR PORTABLE TOOLS AND LIGHTS



Flexible as a lamp cord. Protected by a seine twine braid specially treated to withstand rough use. Recommended for portable tools and lights in machine shops, garages, shipyards and on any engineering or construction work where conditions are severe and continuous service is essential.

Send for descriptive circular No. 6.

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is appreciated by most manufacturers because it brings in business. It brings business because when catalogs are distributed to proper buyers they are placed near the engineer's or other buyer's desk for reference.

And have you ever noticed which catalogs get the choicest, handiest, most finger-marked locations near the desk. It is usually the big catalogs that carry many lines. Why? Because the engineer's job is a job of intelligent selection. He must know what there is to select from before he can select.

If he had a catalog that listed *competing lines* side by side *it* would get the *most choice* location because it would save him work.

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1	½	Northern	900
1	2	Westinghouse	1200
1	2	Northern	1200
1	2	Sprague-Lundell	1200
1	2	General Electric	1100
1	2	General Electric, type CVC, shunt, interpole	1100
1	2	Robbins & Myers	800
2	2	Northern	775
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2	3	Peerless	1800
1	3	C. & C	1700
1	3	Gen. Elec., interpole	1700
1	3	Electro-Dynamic	1650
1	3	Crocker-Wheeler	1300
2	3	Sprague-Lundell	1180
4	3	Western Elec	1150
1	3	Northern	1100
1	3	Gen. Elec., interpole	1100
1	3	Allis-Chalmers	1025
1	3	Crocker-Wheeler	900
1	3½	Willey	400
1	4	Watson	2100
1	5	Gen. Elec., shunt, interpole, new	1700
1	5	Northern	1350
1	5	Western Elec., shunt, interpole, new	1150
1	5	Submerged Elec. Co.	1100
1	5	Roth	1100
1	5	Sprague-Lundell	1100
1	5	Western Elec	1000
1	5	Jants & Leist	850
1	5	Western Elec	525
1	5	Reliance, MP, interpole, variable speed, for machine tool drive	310-1000
6		Western Electric	1000
1	7½	General Electric	1400
1	7½	Colonial	1300
1	7½	Westinghouse, interpole	1150
1	7½	Peerless	900
1	7½	Northern	600
2	7½	Roth, interpole	550
1	7½	Western Elec	540
1	7½	Westinghouse, interpole, variable speed	400-1600
1	7½	Triumph	260
10		Robbins & Myers	1250
1	10	National	950
1	15	National	1200

220-VOLT, D.C. MOTOR

Hp.			Speed
1		Westinghouse	1750
1	1½	Western Elec	1300
1	1½	Westinghouse	1200
1	2	Northern	1200
1	2	Roth	1100
1	2	Jenney	1050
1	2	Watson	850
3	3	Fairbanks-Morse	1400
1	3	Peerless	1245
1	3	Sprague-Lundell	1200
1	3	General Electric, int	1150
1	3½	Aaron	850
1	3½	Gen. Elec	850
1	4½	Western Elec	1725
1	5	Gen. Elec	1800
2	5	Crocker-Wheeler	980
1	5	Western Elec	900
1	5	Northern	900
1	5	Ft. Wayne	750
3	5	Colonial	580
1	7½	Westinghouse, comp	1700
1	7½	Westinghouse	1350
1	7½	Sprague-Lundell	1100
1	7½	Roth	850
1	10	Milwaukee	800
1	10	Northern	750
4	10	Roth	750
1	15	Roth, interpole	1200
1	15	Gen. Elec	800
1	15	Allis-Chalmers	600
1	15	Triumph	520
1	20	Crocker-Wheeler	775
1	20	Western Elec., type K, comp., crane or hoist motor	700
4	20	Allis-Chalmers, MP, type K, shunt, interpole, variable speed	650-1300
1	20	Crocker-Wheeler	500
1	25	Allis-Chalmers	1200
1	25	Crocker-Wheeler	750
1	25	Crocker-Wheeler	750
1	25	Western Electric	600
1	25	Westinghouse	400
2	27	Sprague-Lundell, 6-pole, type RT, series wound	275
1	30	Milwaukee	630
1	35	General Electric	1100
2	35	General Electric	875
1	35	Northern	575
1	35	Gen. Elec., comp., interpole, variable speed	375-850
1	40	National	550
1	40	Westinghouse	500
1	45	Holtzer-Cabot	825
1	50	Allis-Chalmers	550
4	50	Westinghouse	525
1	50	Westinghouse	450
3	55	Allis-Chalmers	900
1	65	C. and C	525
4	75	Allis-Chalmers	325
1	90	Western Elecric	525
1	100	Allis-Chalmers	850

3-PHASE, 60-CYCLE MOTORS

Hp.			Speed
1	7½	Westinghouse, type CCL, 220-v	1120
1	15	Wes ern Electric (G. E.), type MT (frame 322), new, 440-volt, slip-ring, variable speed, with G. E., type T-129-C nonreversing drum controller and CE-3223 resistor	900
1	20	Howell, 440-v. (frame 340), new	900
1	25	Fairbanks-Morse, type B, 440-volt, new	1800
1	25	Howell, 220-volt (frame A437), new	600
1	30	Western Electric (G. E.) type MT (frame 342), new, 440-volt, slip-ring, constant speed	720
1	30	Western Electric (G. E.), type MT (frame 342), new, 440-volt, slip-ring, variable speed	720
1	40	Western Electric (G. E.), type MT (frame 336), new, 440-volt, slip-ring, constant speed	1200
1	40	Western Electric (G. E.), type MT (frame 336), new, 440-volt, slip-ring, variable speed	1200
1	40	Allis-Chalmers, 440-volt	865
3	50	Western Elec. (G. E.), type KT (frame 343), form B, 220-volt, new	1200
3	50	General Electric, type KT (frame 343), form B, 440-v., new	1200
1	50	Western Electric (G. E.), type KT-346, form B, 220-volt, new	900
1	50	General Electric, type KT, form B, 440-volt, new	900
2	50	Western Electric (G. E.), type MT (frame 343), new, 440-volt, slip-ring, constant speed	1200

Alternating Current Motors

3-Phase, 60-Cycle Motors

Qu.	Hp.	Make	Volts	Type	Speed
6	1	General Electric	220	KT	900
1	1	General Electric	110	KT	1800
1	2	General Electric	440	KT	1200
2	5	General Electric	220	KT	1200
2	5	General Electric	440	KT	1800
3	7½	General Electric, motors only	550	KT	1800
1	7½	Westghse., slip, motor only	220	HF	1200
1	10	Westingh use	220/440	CCL	1200
1	10	General Electric	220/440	KT	1200
1	10	G. E., bk. guared	550	I	600
1	10	Fairbanks-Morse	220	B	1200
1	15	Triumph	220	....	850
2	15	General Electric	220/440	KT	1800
1	15	Lincoln	220	....	1200
1	15	General Electric	440	KT	1200
1	20	General Electric	220	KT	1800
1	20	Gen. Elec.	220	I	1200
1	25	F.-M., vertical	220/440	UH	900
6	25	General Electric	440	KT	1200
1	30	Westghse., new	220	CS	1170
3	30	Westinghouse	440	CS	1160
1	30	Westghse., New	220	CS	685
6	30	Gen. Elec. New	440	KT	1200
6	30	Gen. Elec.	220	KT	1800

3-Phase, 60-Cycle Motors—Cont'd

Qu.	Hp.	Make	Volts	Type	Speed
3	30	Gen. Elec.	220	KT	1200
1	30	Wagner, New	440	BP	850
5	35	Westinghouse	440	CS	1160
3	50	Westinghouse	440	CS	900
4	50	Western Elec.	440	KT	900
1	50	Fort Wayne, vert.	440	M	1800
1	50	Allis-Chalmers	220	....	1750
1	50	Gen. Elec., New	440	KT	900
1	60	Gen. Elec.	2300	K	720
1	75	Gen. Elec.	440	KT	900
1	75	Westinghouse	440	CS	1160
1	100	Gen. Elec., New	440	KT	720
1	100	Allis-Chalmers	550	....	690
1	150	Westinghouse	220	CS	1200

Write, wire or telephone if you need any kind of a Dynamo or Motor. We have a large stock always on hand. Inquire of our responsibility. We are reputable and responsible, and handle only high-grade electrical machinery.

2-Phase, 60-Cycle Motors

Qu.	Hp.	Make	Volts	Type	Speed
1	½	Gen. Elec.	220	....	1800
2	1	Westingh use	220	C	1700
1	1	Westinghouse	220	....	1725
1	1	Westghse., New	220	CSA	1140
1	1	Gen. Elec.	220	IQ	1800
2	2	Westinghouse	220	CCL	1120
1	3½	Watson, motor only	220	HK	1720/850/550
11	5	Westinghouse	220	CCL	850
1	7½	Westghse., slip. motor only	220	HF	1120
1	7½	Westinghouse	220	CCL	850
1	10	Westinghouse	220	CCL	850
1	10	Crocker-Wheeler	220	Q	1200
14	10	General Electric	220	KQ	1800
2	15	Westinghouse	220	....	1160
5	20	Allis-Chal., New	220	....	1150
1	20	Fb.-Morse	220	....	1800
1	25	Fb.-Morse	220	B	1200
1	25	Westghse., New	220	CS	1160
1	25	Westghse., New	220	CS	870
7	25	Westinghouse	220	CS	1200
1	30	General Electric	220	KQ	900
3	40	Westghse., New	220	CS	870
1	40	Westinghouse	220	C	1800
10	40	Westinghouse	220	CS	870
1	20	Westghse., New	220	CS	1170
2	50	Westghse., New	220	CS	870
1	50	Westinghouse	220	C	850
1	50	Westinghouse	220	CS	1120
1	50	Allis-Chalmers	220	....	865
10	50	Westinghouse	220	CCL	850
2	50	Gen. Elec.	220	KQ	900
1	50	Fb.-Morse	220	....	900
1	50	Ft. Wayne, vert.	220	M	1800
1	60	Westinghouse	220	C	1200
1	100	Allis-Chalmers	220	AN	690
1	125	Gen. Elec.	220	M	600
1	200	Gen. Elec.	220	K	600

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1—2500-kw. Westinghouse horizontal turbo unit, 3-phase, 60-cycle, 2300-volts, 1200 r.p.m., with direct connected exciter and complete with condensing equipment including motor driven air and circulating pumps.
1—500-kw. G. E. vertical turbo unit, 3-phase, 60-cycle, 2300-volts, 1800 r.p.m., with or without condensing equipment.
1—500-kw. G. E., 3-phase, 60-cycle, 2300-volt alternator, direct connected to 20 x 40 x 30 McIntosh & Seymour cross compound engine, 150 r.p.m.
1—400-kw. Westinghouse, 3-phase, 60-cycle, 2200-volts, 3600 r.p.m. turbo unit.
1—125-kva. General Electric horizontal, 3-phase, 60-cycle, 440-volts, 3600 r.p.m.
1—100-kw. G. E. horizontal, 3-phase, 60-cycle, 2300, 440 or 220-volts, 3600 r.p.m., with or without condenser and pump.
1—75-kw. Westinghouse, 220-volts, 2-phase, 60-cycle alternator, direct connected to 12 x 14 Ball & Wood engine, 277 r.p.m.

ROTARY CONVERTERS

1—700-kw. Gen. Elec., 6-phase, 25-cycle, A. C. 250-volts, D.C. 500 r.p.m. synchronous rotary converter.
1—300-kw. Westinghouse, 2-phase, 60-cycle, 400-volts A.C., 550-volts D.C., 600 r.p.m.
2—200-kw. G. E., 3-phase, 25-cycle, 85-volts A.C., 125-volts D.C., 375 r.p.m.
1—150-kw. Westinghouse, 2 or 3-phase, 185-volts A.C., 250-volts D.C., 720 r.p.m.

FREQUENCY CHANGER SET

1—600-kva. Allis-Chalmers, 3-phase, 60-cycle, 2300-volts on one end; 3-phase, 25-cycle, 6600-volts on other end.
1—400-kw. Gen. Elec., 3-phase, 25-cycle, 6000-volts one side; 2400-volts, 2-phase, 60-cycle, other side, 375 r.p.m.

MOTOR GENERATORS SETS

1—150-kw. G. E., 250-volts, type MP generator, direct connected to 2-phase, 60-cycle, 2300-volt motor, 514 r.p.m.
1—108-kw. Cro-Wheeler, type SECD, 36-volt generator, direct connected to 165-hp. Cro-Wheeler 230-volt motor, 500 r.p.m.
1—100-kw. Westinghouse, 500-volt generator, direct connected to 150-hp. Westinghouse, 2-phase, 60-cycle, 2200-volt motor, 580 r.p.m.
1—10-kw. Westinghouse, 125-volts, 1120 r.p.m. generator, coupled to 15-hp. Westinghouse, 2-phase, 60-cycle, 440-volt motor.

3-PH., 60-CY. MOTORS

1—400-hp. G. E., 2200-volts, 900 r.p.m.
1—300-hp. G. E., 440-volts, 900 r.p.m.
1—300-hp. Gen Elec., 440-volts, 450 r.p.m.
1—200-hp. G. E., 440-volts, 600 r.p.m.
1—175-hp. Gen. Elec., 550-volts, 600 r.p.m.
2—150-hp. Westinghouse CW., 2200-volt, 870 r.p.m.
1—150-hp. Westinghouse, CW., 440-volt, 1170 r.p.m.
1—150-kva. Westinghouse, 240-volt, 900 r.p.m.
1—75-hp. West. Elec., 2200-volts, 870 r.p.m.
9—35-hp. G. E., 440-volts, 900 r.p.m.
1—30-hp. Westinghouse, 550-volts, 840 r.p.m.
2—25-hp. Westinghouse, CS, 440-volts, 1160 r.p.m.
4—25-hp. G. E., 440-volts, 1200 r.p.m.
3—25-hp. G. E., 440-volts, 600 r.p.m.
8—25-hp. Westinghouse, CS, 440-volts, 865 r.p.m.
2—15-hp. G. E., 440-volts, 1200 r.p.m.

2-PH., 60-CY. MOTORS

1—75-hp. G. E., 440-volt, 900 r.p.m.
1—40-hp. Cro-Wheeler, 220-volts, 685 r.p.m.
1—25-hp. G. E., 220-volts, 1200 r.p.m.
1—15-hp. Westinghouse, 200-volts, 900 r.p.m.

3-PH., 25-CY. MOTORS

1—200-hp. Westinghouse, 440-volts, 430 r.p.m.
1—200-hp. Westinghouse, 400-volt, 365 r.p.m.
1—20-hp. Allis-Chalmers, 220-volts, 720 r.p.m.

TRANSFORMERS—60-CY.

4—1250-kva. G. E., 26400/13200-volts, prim. 2400/2200-volts secy.
3—1000-kva. Pittsburgh, outdoor type, Scott connected, 13200-volts, 3-phase, 2400-volts, 2-phase, with taps for 2600/2500/2300-volts.
4—750-kw. G. E., 44000/43000/42000-volts, prim. 6600 secy.
3—500-kva. Pittsburgh, 6600-volt prim., 2300 secy.
3—200-kva. G. E., 2200-volt prim., 370-volt secy.
2—200-kva. G. E., 9200-volt prim., 440-volt secy.
3—150-kva. Bullock, 2180/2300/2420-volt prim., 440-volt secy.
2—100-kw. Westinghouse, 13200-volt prim., 375 secy.
3—100-kw. G. E., 9200-volt prim., 2300-volt secy.
3—100-kw. Westinghouse, 9000/11000-volt prim., 110/220/440 secy.

TRANSFORMERS—25-CY.

3—185-kva. G. E., 2300-volt prim., 430 volts.
2—150-kva. G. E., 6600-volt prim., 440 volts.
3—125-kw. Westinghouse, 6600-volt prim., 440-volts.

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CENTRAL STREET and GOODRICH PLACE, KANSAS CITY, MO.

25-CYCLE, 3-PHASE, 220-440-VOLT MOTORS

No.	Hp.	Name	Speed
1	1	General Electric	1500
1	2	General Electric	750
1	2	General Electric	750
1	5	Western Electric	1420
1	10	Westinghouse Elevator	650
1	15	General Electric	1500
1	15	Burke	720
1	75	Wagner	750

60-CYCLE, 3-PHASE, 220-VOLT MOTORS

No.	Hp.	Name	Speed
2	½	Westinghouse	1700
1	½	Century (New)	1750
1	1	Westinghouse	1700
1	2	Robbins-Myers (New)	1150
1	2	Robbins-Myers (New)	1750
1	3	Century (New)	1720
1	3	Robbins-Myers	1750
3	3	Robbins-Myers (New)	850
6	3	Robbins & Myers (New)	1150
35	5	Robbins & Myers (New)	1750
1	5	Allis-Chalmers (Sl. rg.)	1200
2	5	Robbins & Myers (New)	1150
1	7½	Robbins & Myers, elev. type	1200
8	7½	Robbins & Myers (New)	1150
6	7½	Robbins & Myers (New)	1750
4	7½	Robbins & Myers (New)	850
1	10	Wagner (New)	1750
2	10	Robbins & Myers (New)	1150
5	10	Robbins & Myers (New)	1750
2	10	Robbins & Myers (New)	850
2	15	Robbins & Myers (New)	1150
3	20	Robbins & Myers (New)	850
1	20	Westinghouse	860
2	25	Robbins & Myers (New)	1350
3	25	Robbins & Myers (New)	1150
2	25	Robbins & Myers (New)	850
1	25	Western Electric	1120
1	30	Western Electric	900
2	30	Robbins & Myers (New)	1150
1	30	General Elec. slip ring	900
1	35	Wagner	1730
1	40	Allis-Chal. (New) slip ring	860
1	40	Allis-Chal., 2200-V.	865
1	50	Allis-Chal., squirrel cage, 2200-V.	865
1	50	Allis-Chalmers	575
1	50	Allis-Chalmers (slip ring)	875
1	75	Allis-Chalmers	900
1	75	Ft. Wayne, 2200-V.	900
1	100	General Electric	1170
1	125	Allis-Chalmers	1800

220 VOLT D.C. MOTORS

No.	Hp.	Name	Speed
1	5	Northern	1150
1	5	General Electric	1725
1	5	Northern	1575
1	5	Crocker-Wheeler, new	1875
1	7½	General Electric	815
1	7½	Browning	935
1	7½	Westinghouse	1350
1	7½	Ideal	1500
1	7½	General Electric	1300
1	7½	Northern	1650
5	10	Crocker-Wheeler	825
1	10	Northern back-gear	1200
1	10	American Engine Co.	1140
1	10	Westinghouse	1150
1	15	Electric Mchy. Co.	1050
1	15	General Electric (Crane)	600
1	15	Northern	535
3	30	General Electric (Vertical)	1500
1	110	Crocker-Wheeler	560

110-VOLT D.C. GENERATORS

No.	Kw.	Name	Speed
1	40	G. E.	1150
1	65	General Electric	875
1	75	W. E., engine type	275

220-VOLT, D. C. GENERATORS

No.	Kw.	Name	Speed
1	30	Northern	1000
1	75	Northern	700
1	80	Thompson-Ryan	600
1	80	Milwaukee	650
1	125	Ft. Wayne	600
1	200	Northern	500

DIRECT CONNECTED SETS

1—27½-kw., 110-volt, 305-r.p.m. General Electric Generator, direct connected to Chuse & Co. steam engine.

1—30-kw., 220-volt, 300-r.p.m. Akron Generator, direct connected to 10 x 10 Buffalo Forge Co. engine, complete.

1—30-kw., 220-volt, 300-r.p.m., Sprague Generator, direct connected to 10 x 10 Ideal steam engine, complete.

1—50-kw., 125-volt, 280-r.p.m. General Electric Generator, direct connected to 11 x 12 G. E. Marine steam engine, complete.

1—300-kw., 220-volt, Crocker-Wheeler Generator direct connected to 18 x 30 x 42 Cross compound Corliss engine.

ALTERNATORS

1—50-kw., 220-volt, 60-cycle, 3-phase, 3600-r.p.m. Burke Alternator, direct connected to 50-kw. turbine, complete.

1—62½-kw., 2200-volt, 60-cycle, 3-phase, 300-r.p.m. Bullock Alternator, direct connected to an Aimes steam engine, all complete.

1—75-kva., 2300-volt, 1200-r.p.m., 60-cycle, 3-phase Western Electric Alternator, complete.

1—80-kva., 2300-volt, 60-cycle, 3-phase, 225-r.p.m. Ft. Wayne Alternator, direct connected to 110-hp. Buckeye producer gas engine, complete.

1—100-kva., 2300-volt, 60-cycle, 3-phase, 277-r.p.m. Westinghouse Alternator, direct connected to 125-hp. Erie engine.

3—100-kw., 440-volt, 60-cycle, 3-phase, 3600-r.p.m. General Electric Curtiss type turbines complete with jet condensers for each machine driven by steam pumps, two synchronous motor generator exciter sets, one Curtiss turbine exciter set all complete with necessary rheostats and nine panel switchboard.

1—150-kva., 2300-volt, 60-cycle, 3-phase 200-r.p.m. General Electric Alternator, direct connected to a 14½ x 24 x 18 Mansfield automatic steam engine, complete.

1—150-kva., 2300-volt, 60-cycle, 3-phase, 720-r.p.m. Electric Machinery Alternator, complete with exciter

BILL WRIGHT *says:*

"Speaking of that song 'Bubbles' reminds me I saw in the paper the other day where a fellow out in Nebraska ate a bar of soap. And now they say he's blowing . . . . well he's blowing about how easy it is to get a bucket of suds in Bryan's own state.

"Some folks 'blow bubbles' in business. But not HALL. If a machine is used, he'll tell you so! and you'll never get it if it isn't in A-1 condition!"

Dependable Equipment

New and Used — Guaranteed Condition — Ready to Ship

ALTERNATING CURRENT MOTORS

3-PHASE, 60-CYCLE

Quan.	Hp.	Volts	Speed	Make	Type	New Used
1	200	440	600	General Electric, sq. cage	K	New
1	150	2200	720	General Electric, sq. cage	K	New
1	150	220/440	600	Westinghouse, sq. cage	CS	Used
1	100	2200	720	General Electric, wound rotor	L	Used
2	100	440/220	900	General Electric, sq. cage	K	New
2	100	440/220	720	General Electric, sq. cage	K	New
1	100	2200	600	General Electric, sq. cage	K	New
2	100	2200	900	General Electric, sq. cage	K	New
2	100	2200	720	General Electric, slip ring	M	New
1	75	440/220	720	General Electric, sq. cage	KT	New
4	50	440/220	1200	General Electric, sq. cage	KT	New
3	50	440/220	900	General Electric, sq. cage	KT	New
1	50	220/440	900	General Electric, wound rotor	L	Used
2	50	440/220	720	General Electric, sq. cage	KT	New
1	50	220/440	900	Allis-Chalmers, sq. cage	AN	Used
1	35	220/440	900	General Electric, sq. cage	K	Used
1	35	220/440	900	General Electric, slip ring	M	Used
2	30	440/220	900	General Electric, wound rotor	L	Used
1	25	440/220	600	General Electric, sq. cage	K	Used
1	25	440/220	1200	General Electric, sq. cage	K	Used
1	20	440/220	600	General Electric, sq. cage	K	Used
1	20	440/220	900	General Electric, wound rotor	L	Used
4	20	440/220	1200	General Electric, wound rotor	L	Used
4	15	440/220	1200	General Electric, wound rotor	L	Used
4	10	440/220	1200	General Electric, wound rotor	L	Used
3	7½	440/220	1200	General Electric, wound rotor	L	Used
3	5	440/220	1200	General Electric, wound rotor	L	Used

2-PHASE, 60-CYCLE

1	50	220	1200	Westinghouse, sq. cage	CCL	Used
1	35	220	900	General Electric, sq. cage	KO	Used
3	20	220/440	1200	General Electric, wound rotor	L	Used
1	20	220/440	900	General Electric, wound rotor	L	Used
4	15	220/440	1200	General Electric, wound rotor	L	Used
5	10	220/440	1200	General Electric, wound rotor	L	Used
2	7½	220/440	1200	General Electric, wound rotor	L	Used

3-PHASE, 25-CYCLE

1	80	220/440	750	Westinghouse, slip ring	HF	Used

DIRECT CURRENT MOTORS

Quan.	Hp.	Volts	Rpm	Make	Type	New Used
1	60	230	800	Westinghouse	S	Used
1	55	230	800	Sprague	SL	Used
1	50	230	750	Westinghouse, interpole	SK	Used
1	50	230	750	Westinghouse, interpole	SK	New
1	50	230	850	Sprague	D	Used
1	30	230	615	Sprague	D	Used
1	20	115	1150	General Electric, interpole	RC	Used
1	15	230	800	Crocker-Wheeler	I	Used

DIRECT CURRENT GENERATORS

1—60-kw., 125-volt, 800-r.p.m., compound wound, interpole General Electric, Type DLC, new Generator, rated 40 deg. C., complete with base, pulley and rheostat.
1—40-kw., 250-volt, 850-r.p.m., compound wound Westinghouse, type SK, Generator, complete with base, pulley and rheostat.
1—30-kw., 125-volt, 1150-r.p.m., compound wound Crocker-Wheeler Generator, complete with base, pulley and rheostat.
2—30-kw., 125-volt, 1050-r.p.m., compound wound General Electric, type MP, form H Generators, complete with bases, pulleys and rheostats.
1—17-kw., 250-volt, 1125-r.p.m., compound wound Westinghouse type S, Generator complete with base, pulley and rheostat.

MOTOR GENERATOR SETS

1—60-kw., 125-volt, 850-r.p.m., compound wound, new General Electric, Type DLC, Interpole Generator, rated 40 deg., coupled by means of flexible couplings to 100-hp., 440/220-volt, 3-phase, 60-cycle, new General Electric, squirrel cage motor, complete with rheostat and starting compensator.
1—60-kw., 125-volt, 850-r.p.m., compound wound new General Electric, Type DLC, Interpole Generator, rated 40 deg. C., coupled by means of flexible couplings to 75-hp., 220/440-volt, 2-phase, 40-cycle (will reconnect to 550-volt, 3-phase) 800-r.p.m., new General Electric, Form L, wound rotor type Motor, complete with rheostat and starting apparatus.
1—40-kw., 250-volt, 850-r.p.m. Westinghouse, type SK, D.C. Generator, coupled by means of flexible coupling to 60-hp., 440/220-volt, 3-phase, 60-cycle, new General Electric, squirrel cage motor, complete with rheostat and starting compensator.
1—30-kw., 125-volt, 1150-r.p.m. Crocker-Wheeler, D.C. Generator, coupled by means of flexible coupling to 50-hp., 220-440-volt, 3-phase, 60-cycle new General Electric, squirrel cage motor, complete with rheostat and starting compensator.
1—17½-kw., 250-volt, 1800-r.p.m., compound wound, Interpole General Electric, D.C. Generat r, mounted on sub-base with and direct connected to one 440-volt, 3-phase, 60-cycle Squirrel Cage motor, complete with rheostat and compensator

Prompt Service and Nothing But Good Equipment

STEPHEN HALL & CO., *Inc.*

90 WEST STREET, NEW YORK — TELEPHONES: RECTOR 3891, 3892, 3893

TIFFANY HALL & CO., Inc.

ELECTRICAL EQUIPMENT - ENGINEERS
ALSO SPECIALISTS IN HEAVY AND DIFFICULT REPAIRS

IN STOCK

MOTOR GENERATOR SETS

1—250-kw., set consisting of 250-kw., 450-R.P.M., 250-volt, 6-pole direct current, compound wound Fort Wayne Generator, complete with field rheostat, and direct connected by means of flexible coupling to 375-HP. 2200-volt, 450-R.P.M., 3-phase, 60-cycle Westinghouse, revolving field synchronous motor, complete with starting apparatus and field rheostat for motor.

1—200-kw. set consisting of 200-kw., 580-R.P.M., 250-volt, direct current, 6-pole compound wound Sprague-General Electric Generator, complete with field rheostat and direct connected by means of flexible coupling to 300-HP. (50 deg. C.) 580-R.P.M., 2200-volt, 3-phase, 60-cycle General Electric, form K, squirrel cage type induction motor, complete with starting apparatus.

1—100-kw. set, consisting of 100-kw. 900-R.P.M., 250-volt General Electric, direct current, interpole DLC Generator, complete with field rheostat, and direct connected by means of flexible coupling, with 150-HP. 2200-volt, 900-R.P.M., 3-phase, 60-cycle General Electric revolving field synchronous motor, complete with starting apparatus; above set mounted on one cast iron subbase.

ROTARY CONVERTERS

1—500-kw., 720-r.p.m., 230-volt, D.C. (187-volt, A.C.), 3-phase, 60-cycle, General Electric, type HCC, interpole rotary converter, complete with three 165-kva., 33,000/11,000-volt primary, 187-volt secondary, single-phase, 60-cycle transformers.

1—500-kw., 720-r.p.m., 250-volt, direct current, 187-volt, A.C., 3-phase, 60-cycle General Electric, type HCC rotary converter, complete with three 165-kva. 6600/11,400-volt primary, 187-volt secondary, single-phase, sixty-cycle, type HJ General Electric transformers, complete.

Immediate shipment on the above items.

MOTORS

F. O. B. Hoboken—*Prompt Shipment*

Stock No.	*Hp.*	*Volts*	*Speed*	*Ph.*	*Cy.*	*Make and Type*
2294A	350	230	400	DC	DC	G. E. Ft. Wayne, comp. wd.
2385	250	2200	600	3	60	G. E. "K" (3 bearing).
2338A	200	230	450	DC	DC	Ft. Wayne G. E. comp. wd.
2524	250	440	500	3	25	G. E. form P.
Consign	200	230	475	DC	DC	Sprague-Compound wound
2523	200	2200	720	3	60	Westinghouse CW, Silo Rin :
2035	150	550	575	3	60	Western Elec. sq. cage.
2005	150	2200	575	3	60	Western Elec. sq. cage.
1842	150	220	600	2	60	Crocker Wheeler (consign).
2526	150	220/440	1800	3	60	Crocker Wheeler.
2313	125	230	430	DC	DC	Crocker Wheeler interpole.
2000	125	2200	575	3	60	Western Elec. sq. cage.
2041	125	550	575	3	60	Western Elec. sq. cage.
2003	125	2200	575	3	60	Western Electric sq. cage.
2295A	100	115	875	DC	DC	Ft. Wayne, G. E. "LB".
1997	100	2200	600	3	60	Western Elec. sq. cage.
2047	100	220/440	695	3	60	Western Elec. sq. cage.
2296	100	220/440	1200	3	60	Gen. Elec. sq. cage, K.
1991	75	2200	870	3	60	Allis Chalmers sq. cage.
1979	75	2200	870	3	60	Western Elec. sq. cage.
1987	75	2200	870	3	60	Western Elec. sq. cage.
2051	75	550	870	3	60	Western Elec. sq. cage.
2055	75	220	870	2	60	Western Elec. sq. cage.
1975	75	2200	900	3	60	Western Elec. sq. cage.
2493	75	220	720	3	60	G. E. "K".
Consign	75	220/440	300	3	60	Westinghouse slip ring "CW".
1930	60	2200	1200	3	60	Allis Chalmers (consign).
1974	60	2200	720	3	60	Western Electric.
2313	60	230	215/430	DC	DC	Crocker Wheeler, interpole.
1971	60	2200	695	3	60	Western Elec. sq. cage.
1972	60	2200	695	3	60	Western Elec. sq. cage.
2502	50	440	600	3	60	G. E. KT
2489	50	230	650	DC	DC	G. E. RC, compound wound.
2399	50	440	720	3	60	G. E. "K".
2411	40	440	900	3	60	G. E. "KT" (50-deg. C.)
2412	40	440	900	3	60	G. E. "KT" (50-deg. C.)
2413	40	440	900	3	60	G. E. "KT" (50-deg. C.)
2414	40	440	900	3	60	G. E. "KT" (50-deg. C.)
2415	40	440	900	3	60	G. E. "KT" (50-deg. C.)
2416	40	440	900	3	60	G. E. "KT" (50-deg. C.)
2417	40	440	900	3	60	G. E. "KT" (50-deg. C.)
2418	40	440	900	3	60	G. E. "KT" (50-deg. C.)
2419	40	440	900	3	60	G. E. "KT" (50-deg. C.)
2420	40	440	900	3	60	G. E. "KT" (50-deg. C.)
2421	40	440	900	3	60	G. E. "KT" (50-deg. C.)
2422	40	440	600	3	60	G. E. "KT" (50-deg. C.)
2423	40	440	600	3	60	Westinghouse CS 50-deg. C.
2424	40	440	600	3	60	G. E. "K" (50-deg. C.)
2425	40	440	600	3	60	Westinghouse CS 50-deg. C.
2503	40	440	600	3	60	G. E. KT., 50-deg. C.
2504	40	440	600	3	60	G. E. KT., 50-deg. C.
2505	40	440	900	3	60	G. E. KT., 50-deg. C.
2506	40	440	600	3	60	G. E. KT., 50-deg. C
2363	40	220	750	3	25	Westinghouse CX
2362	40	220	750	3	25	Westinghouse CX
2366	35	220/440	725	3	25	Westinghouse, type CS
2365	35	220/440	725	3	25	Westinghouse, type CS
2364	30	220	750	3	25	Westinghouse, CCL
2278	30	220	710	3	25	Westinghouse, CCL
1969	30	2200	900	3	60	Western Elec sq. cage.
2277	30	220	710	3	25	Westinghouse, CCL.
2359	30	115	1160	DC	DC	Keystone.
2317	30	115	525	DC	DC	Westinghouse.
1966	30	2200	1200	DC	DC	Western Elec.
2491	30	230	965	DC	DC	General Electric, CLB.
2384	30	440	900	3	60	General Electric KT, (50-deg.)
2382	30	440	600	3	60	Gen. Elec. KT, (50-deg.)
2387	30	220	900	3	60	Gen. Elec. KT, (50-deg.)
2430	30	440	1200	3	60	Gen. Elec. KT, (50-deg.)
2431	30	440	1200	3	60	Gen. Elec. KT, (50-deg.)
2432	30	440	1200	3	60	Gen. Elec. KT, (50-deg.)
2433	30	440	1200	3	60	Gen. Elec. KT, (50-deg.)
2436	30	440	1200	3	60	Gen. Elec. KT, (50-deg.)
2437	30	440	1200	3	60	Westinghouse, CS, (50-deg.)
2438	30	440	1200	3	60	Westinghouse, CS, (50-deg.)
2439	30	440	1200	3	60	Westinghouse, CS, (50-deg.)
2444	30	440	600	3	60	General Elec., KT, (50-deg.)
2443	30	440	600	3	60	General Elec., KT, (50-deg.)
2446	30	440	600	3	60	General Elec., KT, (50-deg.)
2447	30	440	600	3	60	General Elec., KT, (50-deg.)
2448	30	440	600	3	60	General Elec., KT, (50-deg.)
2507	30	440	600	3	60	General Elec., KT, (50-deg.)
2508	30	440	600	3	60	General Elec., KT, (50-deg.)
2509	30	440	600	3	60	General Elec., KT, (50-deg.)
2276	25	220	715	3	25	General Electric, K.
2354	25	220/440	600	3	60	Gen. Elec. K sq. cage.
2371	25	220/440	900	3	60	Gen. Elec. K sq. cage.
2358	25	220/440	1200	3	60	Westinghouse, CCL.
2490	25	230	625	DC	DC	General Elec., CLB.
2332	25	115	1050	DC	DC	Bullock
2449	20	440	1200	3	60	General Electric, KT.
2510	20	440	1200	3	60	General Electric, KT.
2266	20	220	720	3	25	Westinghouse, CX.
2267	20	220	720	2	25	Westinghouse, CX.
2268	20	220	720	3	25	Westinghouse, CX.
2270	20	200	750	3	25	Westinghouse, CX.
2271	20	200	750	3	25	Westinghouse, CX.
2272	20	200	750	3	25	Westinghouse, CX.
2273	20	200	750	3	25	Westinghouse, CX.
2453	15	440	1200	3	60	General Elec., KT.
2454	15	440	1200	3	60	General Elec., KT.
2455	15	440	1200	3	60	General Elec., KT.
2511	15	440	720	3	60	General Electric, KT.
2333	15	115	1100	DC	DC	Westinghouse.
2021	15	220	1200	2	60	Westinghouse, CS.
2397	15	220	1050	DC	DC	General Electric, RC.
2258	15	220	720	3	25	Westinghouse, C.
1503	13	220	875	DC	DC	Westinghouse, S No. 5.
2292	10	440	1800	3	60	General Elec., (50-deg).
2335	10	115	1850	DC	DC	Allis Chalmers-Bullock.
2226	10	115	1150	DC	DC	Westinghouse SK.
2334	10	115	1450	DC	DC	Allis-Chalmers-Bullock.
2222	10	220	1325	DC	DC	Westinghouse, S.
2515	7½	440	720	3	60	General Electric, KT.

BELTED D.C. GENERATORS

2294—One 250-kw., 450-r.p.m., 250-volt, direct current, 6-pole, compound wound Ft. Wayne, General Electric, type M.P.L., complete with rheostat pulley and base.

S2396—One 200-kw., 550-r.p.m., 250-volt, 6-pole, compound wound Sprag General Electric, two-bearing belted Generator complete.

2295—One 70-kw., 125-volt, 975-r.p.m., 6-pole, direct current Ft. Wayne General Electric, type L.B., complete.

1922A—One 25-kw., 250-volt, 750-r.p.m., Allis-Chalmers, compound wound Generator, complete with base, pulley and rheostat.

1850—One 10-kw., 125-volt, 1135-r.p.m., direct current, compound wound Westinghouse type S Generator, complete pulley, base and rheostat.

BELTED A.C. GENERATORS

2110—One 200-kw., 2300-volt, 600-r.p.m., 3-phase, 60-cycle Westinghouse Generator, with base, pulley, belted exciter and rheostat.....3 weeks.

S—2211—One 200-kw., 2300-volt, 720-r.p.m., 3-phase, 60-cycle Fort Wayne General Electric revolving field, complete with base, pulley, belted exciter and rheostat.....2 weeks.

1930—One 60-kw., 2200-volt, 1200-r.p.m., 3-phase, 60-cycle Bullock-Allis Chalmers Generator, complete with base, pulley, rheostat and exciter

OFFICES AND SHOPS

SEVENTH AND ADAMS STS., HOBOKEN, N. J.

Telephones (New York Wire) Rector 5163
Hoboken 720-721

Power Machinery Exchange

INCORPORATED

1 MONTGOMERY STREET, JERSEY CITY, N. J.

3-Phase, 60-Cycle A. C. Units

300-Kw. G. E., 2300-Volt, 3-Phase, 60-Cycle, With Harrisburg Side Crank 4-Valve Tandem Engine

Kw.	Generator	Volts	Engine
800	Al.Chal.	2300-200	Reynolds, 30 x 48
800	Al. Chal.	440-220	Al. Chal. cor.
600	G. E.	2300-220	Corliss, cross comp.
450	G. E.	600-220	Rice, Sargeant, cor.
400	Wghse.	480-240	Erie Ball, 4-valve
360	G. E.	2300-550-220	Harris, cor., 250 rpm.
300	G. E.	2300	Harrisburg, side c.
250	G. E.	600-220	Reynolds, 16 x 36
250	G. E.	2300	Harrisburg, tandem
156	W	2200-220	Harrisburg, side c.
156	Wghse.	440	Parsons Turbine
150	G. E.	440-220	Chandler Tay, s. c.
125	Al. Chal.	220-440	Buckeye, heavy s. c.
100	Ridgway	220	Lycoming, side crank
100	Ridgway	2300-220	Ridgway, 4-valve
75	(2) G. E.	2300-220	Ideal tandem
75	Cr. Wh.	2300-220	Russell, side crank
75	Ridgway	2300	Ridgway, side crank
36	G. E.	240	Harrisburg, side crank

A. C. Motors (60 Cycles)

Hp.	Make	Phase	Volts	Speed
250	G. E.	3	2300	900
200	Wghse.	3	440	580
125	G. E.	3	440	900
100	Wghse.	3	230	1170
100	Al. Chal.	3	220	860
85	G. E.	3	2080	720
75	Wghse.	3	550	720
7½	G. E.	2	220	1800
1	Emerson	1	220-110	1750

110-125-Volt Generators

Kw.	Make	Type	Speed
100	Burke	MP	600
75	G. E.	H	550
60	Walker	MP	700
60	Wghse.	S	800
50	G. E.	L	260
37½	G. E.	H	700
17½	G. E.	H	1080
17	Triumph	MP	1200
15	Bernard	MP	1250
12½	Card	MP	850
11	G. E.	CQ	800
10	Wghse.	S	1325
9½	G. E.	CVC	975
6	Wghse.	S	1675
4½	G. E.	IB	1800
4½	Wghse.	M	1600

Corliss Engines

32 x 48 Allis Chalmers.
26 x 48 Hewes & Phillips.
24 x 56 Watts Campbell.
24 x 48 Hewes & Phillips.
24 x 42 Vilter.
22 x 48 Murry.
22 x 48 Allis.
20 x 42 Allis.
18 x 48 Lane & Bodley.
18 x 42 Allis.
16x 36 Allis.
14 x 36 Allis.
14 x 32 Hewes & Phillips.

220-250-Volt Dir. Con. Units

125-Kw. Wghse., 3-Wire, 125-250-Volt, With Chandler-Taylor Side Crank Heavy Duty Latest Type Engine, Like New

Kw.	Generator	Engine
480	G. E.	McIntosh & Sey., ver.
450	C. W.	Nordberg, Uniflow, cor.
300	Goodman	Ridgway, cross comp.
200	Wghse.	Erie Ball, side crank
150	Burke	Harrisburg, side crank
150	Al. Chal.	Al. Chal., 18 x 36
150	Ridgway	Ridgway
125	Wghse. 3-wire	Chand. Tay., side crank
115	W. E.	Russell, 4-valve
100(2)	Sturtevant	Sturtevant, vertical
75	Wghse., 3-wire	Harrisburg, tandem
75	Wghse., 3-wire	Skinner
75	Wghse.	Wghse, vertical
75	G. E.	Skinner
62½	G. E.	Ames
50	Wghse., 3-wire	Harrisburg
50	Wghse., 3-wire	Harrisburg
50	Cr. Wheeler	Frost
35	G. E.	Harrisburg, side crank
30	Engberg	Engberg, vertical
25	Wghse.	Erie Ball
25	G. E.	Troy, vertical
15	G. E.	Harrisburg, side crank

220-250-Volt Generators and Motors

Kw.	Make	Type	Speed
650	Burke	12 pole	350
325	Jenney	6 pole	400
300	Wghse.	6 pole	450
250	G. E.	6 pole	500
150	Wghse.	6 pole	225
150	G. E.	6 pole	400
100	Triumph	6 pole	675
85	G. E.	CLB	800
75	G. E.	6 pole	725
60	National	CS	875
56½	Wghse.	MP	800
50	G. E.	H	515
40	Milwaukee	MP	650
30	G. E.	H	1050
27(2)	G. E.	H	360
25	G. E.	Crane	800
15	G. E.	MP	1300
15	Wghse.	S	1150
13½	Al. Chal.	MP	1175
10	Wghse.	M	750
10	Akron	MP	1425

3-Phase, 60-Cycle Alternators

Kw.	Generators	Volts	Speed
350	Stanley	2300	600
240	Elec. Machy.	2300	257
200	Al. Chal.	440-240	900
200	G. E.	2300	600
100	G. E.	2300	900
100	G. E.	440-220	900
75	G. E.	440-220	1200
50	Wghse.	220	1200

Oil and Gas Direct Connected Units

500-HP. Diesel Oil Engine, Perfect Condition, Seen Running

Kw.	Make	Type	Engine
200	F. M.	3-ph., 60-cyc.	F. M. 4-cyl. gas
200	F. M.	3-ph., 60-cyc.	Bruce MacB. gas
175	W. E.	3-ph., 60-cyc.	Sheffield, 3-cyl. gas
160(2)	G. E.	3-ph., 60-cyc.	Diesel, 3-cyl. oil
152	G. E.	3-ph., 60-cyc.	Bruce MacB. 4-cyl. gas
120	Burke	3-ph., 60-cyc.	Bruce MacB. 4-cyl. gas
85	Wghse.	3 wire, 220-110 v.	Wghse. 3-cyl. gas
75	Wghse.	250 volt, d.c.	Wghse. 3-cyl. gas
75	G. E.	125 volt d.c.	Diesel, 3-cyl. oil
60(2)	C. W.	125 volt d.c.	Diesel, 3-cyl. oil
50	G. E.	3-ph., 60-cyc.	Rathburn, 2-cyl. gas
37½	F. M.	2-ph., 60-cyc.	F. M., 2-cyl. oil

110-125-Volt Dir. Con. Units

100-Kw. Wghse. 6-Pole Compound Generator, With Skinner Heavy Duty Engine. Like New

Kw.	Generator	Engine
200	Triumph	Ide, side crank 21x20
200(2)	Al. Chal.	Allis, 22x36
150	G. E.	Harrisburg, side crank
150	Wghse.	Ball, 4-valve
125	Bullock	Ball
100	G. E.	Harrisburg, side crank
100	Al. Chal.	Allis, 16x36 corliss
100	Wghse.	Skinner
75	Cr. Wh.	Ames
75	G. E.	G. E., vertical marine
65	Burke	Harrisburg, side crank
60	G. E.	Harrisburg, side crank
50	G. E.	Harrisburg, side crank
50	Wghse.	Harrisburg, side crank
35	Wghse.	Ames
25	G. E.	Harrisburg, side crank
25	Burke	Chand. Tay., side crank
25	Ridgway	Ridgway, side crank
25	G. E.	Bates, vertical
20	Akron	Harrisburg, side crank
15	G. E.	A. & S., vertical

Boilers

Two 600-HP. Babcock-Wilcox Water Tube Boilers, 200 Lb. Pressure. Seen Operating

4—150-hp., Return Tubular Boilers, butt, triple, 125 lb., with stokers. Seen operating.
2—300-hp. Heine W. T., 150 lb. Seen operating.
5—200-hp. Return Tubular Boilers, butt, triple, 135 lb. Seen operating.
1—200-hp. Heine W. T., 150 lb.
1—130-hp. Heine W. T., 150 lb.

STOCK SHIPMENT

ALTERNATING CURRENT MOTORS

3-ph. 60-cy.—40° Rating

No.	Hp.	Rpm.	Volts	Type	Make
3	3	1800	220/440	AN	Allis-Chal.
14	5	1200	220/440	A	Ideal
9	5	1800	220/440	A	Ideal
1	7½	1200	220/440	AN	Allis-Chal.
3	7½	1800	220/440	.....	Fairbanks-M.
3	10	1200	220/440	AN	Allis-Chal.
5	15	1200	220/440	AN	Allis-Chal.
1	20	1800	220/440	.....	Fairbanks-M.
3	25	900	220/440	AN	Allis-Chal.
1	30	700	220/440	BP	Wagner
3	30	900	220/440	AN	Allis-Chal.
9	30	1200	220/440	AN	Allis-Chal.
1	35	1800	220/440	I form K	Gen. Elec.
1	40	900	220/440	AN	Allis-Chal.
2	40	1200	220/440	AN	Allis-Chal.
1	40	1700	2200	CCL	Westghse.
1	50	720	220/440	AN	Allis-Chal.
1	50	855	220/440	CS	Westghse.
3	50	900	220/440	AN	Allis-Chal.
1	50	900	220/440	.....	Howell
1	50	1140	220/440	BW	Wagner
2	50	1200	220/440	AN	Allis-Chal.
1	75	720	220/440	AN	Allis-Chal.
1	75	900	220/440	H	Fairbanks-M.
3	75	900	220/440	AN	Allis-Chal.
4	100	720	220/440	AN	Allis-Chal.
2	100	900	220/440	AN	Allis-Chal.
1	150	575	220/440	.....	West. Elec.
1	150	700	220/440	CS	Westinghouse
1	150	720	2200	AN	Allis-Chal.
1	200	580	220/440	CS	Westinghouse
1	200	720	220/440	AN	Allis-Chal.
1	200	1200	2200	AN	Allis-Chal.

ALTERNATING CURRENT SLIP RING MOTORS

3 ph. 60 cy.—40° Rating

No.	Hp.	R.P.M.	Volts	Type	Make
1	2	1700	220/440	CW	Westinghouse
2	30	1800	220/440	HF	Westinghouse
1	30	900	220/440	AN	Allis-Chal.
2	50	900	220/440	AN	Allis-Chal.
2	100	720	220/440	AN	Allis-Chal.
1	150	720	220/440	AN	Allis-Chal.
1	155	720	220/440	EMV	Burke

DIRECT CURRENT MOTORS

230 Volts

No.	Hp.	Rpm.	Wdg.	Type	Make
1	½	650	Sh	CM	Crocker-Wh.
2	7½	825	Cp	B-7	Milwaukee
1	7½	825	Sh	13	Milwaukee
1	7½	950	Cp	K	Allis-Chal.
1	10	635	Sh	MP	Gen. Elec.
1	10	1150	Sh	S	Westghse.
1	13	1750	Sh	SL	C & C
1	20	600	Sh	.....	West. Elec.
1	20	600	Sh	S	Westghse.
1	20	650	Sh	.....	Northern
1	20	650	Sh	.....	Milwaukee
1	20	900	Sh	MP	Hobart
1	20	850	Sh	S	Westghse.
2	22	1050	Cp.	B-51	Milwaukee
1	40	920	Cp	MP	Jenny
1	40	950	Sh	B-25	Milwaukee
1	40	950	Cp	EB5A	West. Elec.
1	45	800	Sh	.....	Imperial
1	45	600/1200	Sh	.....	Northern
1	50	525	Cp	.....	Northern
1	55	575	Sh	E6¼AOR	West. Elec.
1	75	800	Cp	A50	Milwaukee
3	90	1000	Cp	A-50	Milwaukee
1	95	575	Sh	.....	Jenny
1	115	1000	Cp	DLC	Gen. Elec.
1	267	468	Cp	.....	Commercial
1	650	315	Sh	.....	Burke

DIRECT CURRENT MOTORS

115 Volts

No.	Hp.	Rpm.	Wdg.	Type	Make
1	½	1850	Sh	CQ	Gen. Elec.
1	¾	1650	Sh	CQ	Gen. Elec.
1	1	1400	...	O.B.	West. Elec.
1	1	1100	Sh	Semi-enclosed	Thompson
1	1½	2100	Sh	.....	Browning
1	2	1100	Sh	CCM	Crocker-Wh.
1	2½	1300	Sh	...	Fairbanks-M.
1	3	1650	Sh	CVC	Gen. Elec.
1	3	1650	Sh	CE	Gen. Elec.
1	3	...	Sh	.....	Gen. Elec.
1	4½	300	Sh	.....	Roth
1	5	585	Sh	.....	Peerless
1	5	1040	Sh	.....	Peerless
1	5	1650	Sh	.....	Gen. Elec.
1	5	1800	Cp	.....	Bullock
1	7	740/1675	Cp	S	Westghse.
1	7½	975	Cp	S	Westghse.
1	10	650	Sh	CQ	Gen Elec.
1	10	800	Sp	.....	Gibbs
1	10	1430	Sh	.....	Peerless
1	10	1510	Sh	.....	Peerless
1	13	1070	Sh	CCM	Crocker-Wh.
1	22	1050	Sh	E-15	Milwaukee
1	25	600	Sh	...	Peerless
1	25	825	Cp	SK	Westghse.
1	25	850	Cp	S	Westghse.
1	25	850	Sh	S	Westghse.
1	30	900	Cp	S	Westghse.
1	30	1600	Cp	.....	Triumph
2	50	240	Cp	.....	West. Elec.
2	100	238	Cp	.....	Burke

DIRECT CURRENT MOTORS

500 Volts

No.	Hp.	Rpm.	Wdg.	Type	Make
1	½	1075	Sh	.....	R & M
1	¾	900	Sh	.....	Roth
1	1	1150	Sh	.....	Browning
1	3	1325	Sh	.....	H.P. & S. Co.
1	20	1040	Sh	S	Westinghouse
1	25	1025	Sh	CI	Gen. Elec.
1	50	660	Cp	CCM	Crocker-Wh.
1	265	450	Cp	.....	Westinghouse

DIRECT CURRENT GENERATORS

230 Volts

No.	Kw.	R.p.m.	Wdg.	Type	Make
2	5	925	cp	B-7	Milwaukee
1	5	925	Sh	13	Milwaukee
1	7½	1325	Sh	S	Westge.
1	10	1950	Cp	SL	C. & C.
1	15	1025	Sh	MP	Hobart
1	15	690	Sh	MP	West. Elec.
1	15	725	Sh	MP	Milwaukee
1	30	1020	Cp	MP	Jenny
1	13	1100	Sh	B-25	Milwaukee
1	30	1025	Cp	5-A	West. Elec.
1	35	900	Sh	MP	Imperial
1	40	600	Cp	MP	Northern
1	56	920	Cp	A-50	Milwaukee
3	70	1150	Cp	A-50	Milwaukee
1	70	675	Cp	MP	Jenny
1	80	1050	Cp	DLC	Gen. Elec.
1	85	1150	Cp	DLC	Gen. Elec.
1	200	550	Cp		Commere'l
1	500	375	Sh	MP	Burke
1	625	275	Sh	MP	Burke

MINING MACHINE

1—CE-7 42 in. gauge, 250 V., Sullivan Shortwall Mining Machine, 6 ft. cutter bar.

LOCOMOTIVES

1—7 ton, 250 V., D.C., 42 in. gauge, Morgan-Gardner 2-motor type R Haulage Locomotive,
1—6 ton, 220 V., D.C., 42 in. gauge, Westinghouse Baldwin Haulage Locomotive.
1—8 ton, 250 V., D.C., 36-42 in. gauge, Westinghouse-Baldwin Haulage Locomotive.

MOTOR GENERATOR SETS

230 to 250 Volts

1—5 Kw., 230 V., D.C., 1150 R.P.M., cp.wd. Type K Allis-Chalmers Generator, direct connected to 1—new 220 or 440 V., 3 Ph., 60 Cy. Allis-Chalmers induction motor, complete.

1—10 Kw., 230 V., D.C., 1750 R.P.M., sh.wd. Type SL., C & C Generator, direct connected to 1—new, 220 or 440 V., 3 Ph., 60 Cy. AN Allis-Chalmers induction motor, complete.

1—25 Kw., 230 V., D.C., 1800 R.P.M., Western Electric Generator, direct connected to 1—new, 2200 V., 3 Ph., 60 Cy., Type CCL Westinghouse induction motor, complete.

1—30 Kw., 250 V., D.C., 1150 R.P.M., cp.wd. Type EB5A Western Electric Generator, direct connected to 1—new, 220 or 440 V., 3 Ph., 60 Cy. Allis-Chalmers induction motor, complete.

1—56 Kw., 230 V., D.C., 860 R.P.M., cp.wd. Milwaukee Generator, direct connected to 1—new, 220 or 440 V., 3 Ph., 60 Cy. Allis-Chalmers induction motor, complete.

1—56 Kw., 250 V., D.C., 900 R.P.M., cp.wd. Milwaukee Generator, direct connected to 1—2300 V., 3 Ph., 60 Cy. Allis-Chalmers induction motor, complete.

3—65 Kw., 230 V., D.C., 1150 R.P.M., cp.wd. Milwaukee Generators, direct connected to 3—220 or 440 V., 3 Ph., 60 Cy. Type CS Westinghouse new induction motors, complete.

1—76 Kw., 125-250 V., D.C., 3-wire Western Electric Generator Set, consisting of 2—38 Kw., 125 V., Western Electric Generators, belted or chain driven by 1—new, 220 or 440 V., 3 Ph., 60 Cy. Allis-Chalmers induction motor, complete

1—80 Kw., 250 V., D.C., 1150 R.P.M., Type DLC, cp.wd. General Electric Generator, direct connected to 1—2200 V., 3 Ph., 60 Cy., Type CS Westinghouse induction motor, new, complete.

1—100 Kw., 275 V., 900 R.P.M., cp.wd. Type SK Westinghouse Generator, direct connected and mounted on common base to 1—2200 V., 3 Ph., 60 Cy. Westinghouse synchronous motor, with A.C. starting equipment and D.C. panel.

1—150 Kw., 125-250 V., D.C., 3-wire, Burke Electric Generator Set, consisting of 2—75 Kw., 125 V., cp.wd. Burke generators, belted or chain driven by 1—new, 2200 or 440 V., 3 Ph., 60 Cy. Allis-Chalmers induction motor, complete

DIRECT CURRENT ENGINE GENERATOR SETS

230 to 250 Volts

2—50 Kw., 125-250 V., 285 R.P.M., Burke, cp.wd. Generators, direct connected to 85 Hp., 3-cylinder Walrus Gas Engines, complete with all accessories.

1—56 Kw., 250 V., Type MP. Milwaukee Generator, belted to Ball steam engine, 90 Hp., 100 to 125 lbs. steam pressure, complete with all accessories.

2—75 Kw., 250 V., cp.wd., 290 R.P.M., Westinghouse Generator, direct connected to 1—125 Hp. automatic Westinghouse steam engine complete with all accessories.

1—80 Kw., 250 V., D.C., cp.wd. Type DLC. General Electric Generator, belted to 125 Hp. 100 to 125 lbs. steam pressure, Lord Howler Steam Engine, complete with all accessories.

1—80 Kw., 250 V., cp. wd. Type MP. General Electric Generator, belted to 1—Reeves, 125 Hp. Gas Engine, complete with all accessories.

1—100 Kw., 250 V., 250 R.P.M., 400 Amp., cp.wd., Westinghouse Generator, direct connected to Buckeye 150 Hp. Twin Tandem Gas Engine, complete with all accessories.

1—150 Kw., 250 V., 200 R.P.M., cp.wd., Westinghouse Generator, direct connected to 1—Ridgway horizontal steam engine, 19 in. bore, 20 in. stroke, 225 Hp., 200 R.P.M., steam pressure 125 lbs., complete with all accessories.

1—250 Kw., 275 V., 175 R.P.M., cp.wd. Ridgway Generator, direct connected to Ridgway horizontal steam engine, 23 in. bore, 24 in. stroke, 125 lbs. pressure, complete with all accessories.

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New and used Electrical Equipment
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MOTORS

ACTUALLY IN STOCK. IMMEDIATE DELIVERY

A.C., 3-Phase, 60-Cycle, Squirrel Cage Motors

Qu.		H.P.	Make	Type	Speed	Volts
1	NEW	100	General Electric		900	440
5		100	General Electric		720	440
1	NEW	150	Westinghouse	CS	870	220
1		75	Lincoln	Latest	1800	440
1	NEW	75	Fort Wayne	M	514	440
1	NEW	50	General Electric	KT	1200	220
2		50	Western Electric	KT	900	220
5		50	Fairbanks-Morse	B	900	220
1		50	General Electric	I	600	550
1	NEW	50	Lincoln		600	440
2	NEW	40	General Electric		1800	550
1		40	Wagner	BP	1720	440
1		35	General Electric	I	1800	220
1		35	Wagner	BP	1720	220/440
1		35	General Electric	I	900	440
1		35	General Electric	I	900	220
2		35	Westinghouse	CS	870	220
1		35	General Electric	K	600	220
2		30	Ideal	A	1150	440
1		30	Westinghouse	CCL	1120	2200
2		30	Fairbanks-Morse		1200	440
1		30	Fairbanks-Morse	B	1200	220
1	NEW	25	Westinghouse	CS	3450	440
1		25	General Electric	I	1745	1100/2200
2		25	Fairbanks-Morse		900	220
1	NEW	20	General Electric	KT	900	220
1		20	General Electric	KT	1200	2200
1		20	Crocker-Wheeler	Latest	685	220
1		15	Fairbanks-Morse	H	1800	220
1		15	Robbins & Myers	K	1160	220
1	NEW	15	General Electric	KT	1200	220
1	NEW	15	General Electric	KT	1800	440
1	NEW	15	General Electric	KT	1200	220
1		12	General Electric	I	720	220
2		11	General Electric	KTU	1200	440
1		10	General Electric	KT	1800	220
1		10	Lincoln		1800	220
1		10	General Electric	KT	1165	440
1		10	Fairbanks-Morse	Latest	1200	220
1		10	Westinghouse	CB	1120	220
1	NEW	10	Westinghouse	CS	1150	220
1	NEW	10	General Electric	KT	1200	440
1		10	Robbins & Myers	K	1150	220
1		30	Wagner	BN	1720	220

A.C., 2-Phase, 60-Cycle, Squirrel Cage Motors

1	40	Westinghouse	CCL	1150	220
1	35	Wagner	BP	700	220/440
1	30	Westinghouse	C	1200	220
1	30	Western Electric	KQ	900	220
1 NEW	25	General Electric	KQ	1800	220
1	25	Phoenix	A	1120	220
3 NEW	25	General Electric	KQ	900	220
1	20	General Electric	KQ	1800	220
1	20	Western Electric	CS	1145	220
1	20	Fairbanks-Morse	B	900	220
1	20	Crocker-Wheeler	Latest	860	220
1	20	General Electric	KQ	600	220
1 NEW	15	General Electric	KQ	1800	220
1	15	Wagner		850	220
1	12½	Lincoln		600	210
1	10	Westinghouse	C	1200	220
1	10	Fairbanks-Morse	B	1200	220

A.C., 2-Phase, 60-Cycle, Slip Ring Motors

1	35	Otis		1150	220
1 NEW	30	General Electric	MQ	900	220
2 NEW	25	General Electric	MQ	900	220
1 NEW	10	General Electric	MQ	1800	220
1	133	General Electric	Synchronous	2400	900

D.C., 230-Volt, Variable Speed Motors

1	60	General Electric	DLC	425/850
1	10	Allis-Chalmers	Interpole	500/1000
1	7½	Westinghouse	MP	300/1200
5	7½	Westinghouse	SK	500/1500
4	5	Crocker-Wheeler		1200/1800
1	4	General Electric	CE	375/925
1	3	General Electric	RLC	500/1500
1	3	Westinghouse	S	580/1160
1	3	Northern		375/2000
1	2½	Crocker-Wheeler	CM	535/1600

1-Phase, 60-Cycle, 110/220-Volt Motors

65	2 NEW	Wagner		1750
85	3 NEW	Wagner		1750
3	7½ NEW	Wagner		900
1	15 NEW	Wagner		900
1	15 NEW	Wagner		1200
1	20 NEW	Wagner		1200
1	20	Wagner		1200
1	25	Wagner		1200
1	35	Wagner		1165
1	10	General Electric		1750
1	7½	General Electric		1800

D.C., 550-Volt Motors

1	90	Westinghouse	CLM	690
1	75	Westinghouse	SK	1100
1	60	General Electric	CLB	600
1	50	General Electric	MP	550
4	47	Westinghouse	SA Adj.	600
1	40	Westinghouse		615
1	35	General Electric	CL	650
1	35	General Electric	CB	435-450
1	30	Westinghouse	S	900
1	30	Westinghouse	SK	975
1	30	C & C	MP	350
4	25	Westinghouse	SK	1100
1	25	Westinghouse	MP	1050

A.C. 3-Phase, 60-Cycle, Vertical Motors

1	150	General Electric	I	600	440
3	7½	Western Electric	CL	1800	220
3	5	Fairbanks-Morse		1800	220

D.C., 550-Volt Motors — *Continued*

Qu.	H.P.	Make	Type	Speed
1	25	Westinghouse	SK	825
4	25	General Electric	Vertical	800/1350
1	25	General Electric	RLC	450/900
1	21	Westinghouse		583 Adj.
1	20	General Electric	CQ	1125
1	20	General Electric	MP	1100
1	20	Westinghouse	MP	1050
1	20	Westinghouse	S	1040
1	20	General Electric		925
1	20	General Electric	DLC	925
1	18	Lincoln		875
1	15	Triumph		1150
1	15	Westinghouse	S	620
1	10	Westinghouse	S	1400
1	10	General Electric	CE	1400
1	10	General Electric	IB	1200
1	10	C & C	Open bi-polar	1100
1 NEW	7½	General Electric	RC	1800
1	7½	Bernard		1450
1	7½	Westinghouse	MP	1350
1	7½	General Electric	RC	1300
1	7½	Westinghouse	MP	1350
1	6	C & C	Open bi-polar	1225

A.C., 3-Phase, 60-Cycle, Slip Ring Motors

1	400	Westinghouse	Synchronous	450	2200
1	300	General Electric	L	514	2200
1	200	General Electric	M	666	2200
20 NEW	50	General Electric	MT	720	440/220
1 NEW	50	General Electric	M	900	550
1	40	Westinghouse	CW	1150	220
1 NEW	100	General Electric	RPM	720	440
1	75	General Electric		2200	900
1	75	General Electric	220	L	720
1	50	Fairbanks-Morse		Slip ring	900

D.C., 230-Volt Motors

1	200 Kw.	Sprague		550
1	100 Kw.	C & C		250
1	150	C & C		450
2	75	General Electric	Hoist Motors	
1	60	Elwell Parker	Pedestal Bearing	650
1	43	Sturt	MP	850
1	35	C & C	Open 2 pole	900
1	35	General Electric	CLB	610
1	30	General Electric	DLC	1100
1	30	Westinghouse	S	600
1	25	Sturt	H	950
1	25	General Electric	CLB	300
3	20	Sturt	H	1800
1	20	Sprague	Lundell	750
1	20	C & C	Closed frame	1100
1	20	General Electric	CLB	650
1	16	Westinghouse	MP	625
1	15	Westinghouse	MP	1750
1	15	C & C	SL	1150
1	15	Crocker-Wheeler	Open	825
1	12½	Western Electric		1240
1	12½	Westinghouse	SK	750/1500
1	10	General Electric	CVC	2400
1	10	Sturt	H	1350
1	10	C & C	SL	1320
1	10	C & C	Open bi-polar	1100
1	10	Western Electric		960
1	10	General Electric	CE	800
3	10	Hawthorne	GE	650
1	10	Phoenix		575
1	10	General Electric	RC	1150
1	7½	Sprague		1600
1	7½	Westinghouse	SK	1150
1	7½	General Electric	RC	1150
1	7½	Diehl	G	1150
1	7½	C & C	S	1025
1	7½	Eddy		1000
1	7½	Bell	Open	850
1	7½	Eck		850
1	7½	General Electric	RC	850
1	7½	Crocker Wheeler	Open	825
1	7½	General Electric	CE	675
1	6	C & C	SL	1800
1	6	Westinghouse	S	1465
1	5	General Electric	RC	1700
1	5	Western Electric		1525
1	5	C & C	Open bi-polar	1500
1	5	Eck		1250
1	5	Eck		1080
1	5	Sprague		980
1	5	Browning		915
1	4	Westinghouse	S	1100
1	3	General Electric	CE	1200
1	3	C & C		1550
1	3	Northern		1900
1	3	Excelsior		1650
1	90	Westinghouse	MP compound wound	675

A.C., 3-Phase 25-Cycle, Squirrel Cage Motors

1	50	General Electric	I	715	220
1	40	Allis-Chalmers		720	440
2	20	Westinghouse	CCL	1420	220
1	10	Westinghouse	C	1500	220
3	10	Westinghouse	CS	1440	220
1	7½	General Elec.	KT	1500	440
1	7½	Westinghouse	CS	1400	220

A.C. 2-Phase, 60-Cycle, Vertical Slip Ring

1	15	Westinghouse	HF	865	220

Motor Generator Sets

1—Brand new 6½ H.P. General Electric 2 ph., 60 cy., 220 v. 1200 R.P.M. motor, type K2, with 2½ Kw. type KC 110 v. compound wound Generator, on wooden base.

1—100 H.P. Allis-Chalmers, 3 ph. 60 cy. 220 v. 875 R.P.M. Motor, direct connected to 65 K.w. Bullock 250 v. compound wound D.C. Generator on common cast iron base.

"1000 OTHER MOTORS TOO NUMEROUS TO MENTION"

NATHAN KLEIN & CO.

MOTORS HOWARD & CENTRE STS., N.Y. DYNAMOS

DU PONT

WAR SURPLUS EQUIPMENT

How a turbo-generator paid for itself

Manufacturer buys $13,000 power-machine from Du Pont surplus for $7,500 and saves $7,488 on current besides

A Boston manufacturer who bought a turbo-generator from among our surplus equipment for almost half price, also saved two months power expense by getting immediate delivery.

Before calling upon us, this manufacturer had tried to buy a new generator. He was willing to pay the $13,000 asked for it, but could not wait two months for delivery. Then he came to our plant at Carney's Point and found just the generator he needed for only $7,500. The money he saved on two months power cost, which was $7,488, almost paid for the generator.

While at Carney's Point, this manufacturer also bought other machinery he needed at decided bargain prices. He told us later that he had saved his firm $21,000 on the equipment he purchased.

You, too, can take advantage of this unparalleled sale, and buy the equipment and material you need for your business, at a great saving.

There are more Turbo-Generators for immediate delivery

Condensing and non-condensing turbo-generators. Direct and alternating current. From 300 K. V. A. to 1000 K. V. A.

Buyer can inspect now at our plants, Parlin, N. J., Haskell, N. J., and Hopewell, Va.

An inspection of what we offer in used equipment and material will convince you of its value. Everything is guaranteed to be in serviceable condition.

Don't delay a single day. You must act quickly to get your share of the bargains. Our supply is fast diminishing.

All offerings subject to prior sale.

Write, phone or wire, telling us what you need, or come personally to any of our plants below and see what we have to offer.

Unprecedented opportunity to get good equipment with the high price worn off

- Turbo Generators ☐
- Air Compressors ☐
- Blowers ☐
- Boiler Tubes ☐
- Cafeteria Equipment ☐
- Condensers ☐
- Converters ☐
- Corliss Engines ☐
- Engines with Generators ☐
- F. W. Heaters ☐
- Generator Sets ☐
- Gauges ☐
- Gasoline and Electric Locomotives ☐
- Lubricators ☐
- Duplex Pumps ☐
- Compound Pumps ☐
- Hydraulic Pumps ☐
- Centrifugal Pumps ☐
- Rotary Pumps ☐
- Vacuum Pumps ☐
- Triplex Pumps ☐
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ALTERNATING CURRENT
3-PHASE, 60-CYCLE MOTORS

1—350 hp. General Electric, type I, form K, 2200 volt, 720 r.p.m.
1—200 hp., Crocker-Wheeler, 220-440 volt, 600 r.p.m.
1—100 hp., Westinghouse, Type CCL, 220-440 volt, 680 r.p.m.
1—100 hp., Allis-Chalmers, 220-440 volt, 690 r.p.m.
1— 50 hp., General Electric, Type KT, 220 volt, 1800 r.p.m.
1— 40 hp., Crocker-Wheeler, slip-ring, 220 volt, 1140 r.p.m.
1— 40 hp., Wagner, Type BW, 220-440 volt, 850 r.p.m.
1— 25 hp., General Electric, Type KT, new, 220-440 volt, 720 r.p.m.
1— 20 hp., Crocker-Wheeler, 220 volt, 685 r.p.m.
1— 20 hp., Crocker-Wheeler, 220 volt, 850 r.p.m.
1— 20 hp., General Electric, Type KT, new, 220-440 volt, 1800 r.p.m.
1— 20 hp., General Electric, Form L, 550 volt, 1800 r.p.m.
1— 15hp. Western Electric, type KT, 220-440 volt, 900 r.p.m.

ALTERNATING CURRENT GENERATOR

1—150 kw. Westinghouse, belted, revolving field type, 3 phase, 60 cycle, 2300 volt, 900 r.p.m. with belted exciter, switchboard and instruments.

ALTERNATING CURRENT
2-PHASE, 60-CYCLE MOTORS

1—100 hp., Allis-Chalmers, Type AN, 440-550 volt, 680 r.p.m.
1— 75 hp., General Electric, Form L, 220-440 volt, 720 r.p.m.
1— 50 hp., Allis-Chalmers, Type AN, 220 volt, 570 r.p.m.
2— 30 hp. Fairbanks-Morse, 220-440 volt slip-ring, 900 r.p.m. with drum controllers and resistance.
1— 25 hp., Westinghouse, Type CX, 220 volt, 1120 r.p.m.

ALTERNATING CURRENT
3-PHASE, 25-CYCLE MOTORS

1—200 hp., General Electric, 440 volt, 480 r.p.m.
3— 30 hp., General Electric, 220 volt, 750 r.p.m.
2— 25 hp., Crocker-Wheeler, 220 volt, 750 r.p.m.
1— 15 hp., General Electric, 220 volt, 750 r.p.m.
2— 10 hp., General Electric, 220 volt, 750 r.p.m.

Also a Large Stock of Direct Current Generators and Small Alternating Current Motors

IMMEDIATE "MOTORS" *DELIVERY!*

NEW

Quan.	*Hp.*	*Volts*	*Speed*	*Phase*	*Cycle*	*Make*	*Type*	
1	7½	220	750	3	25	General Electric	KT	New
1	20	220	750	3	25	General Electric	KT	New
4	10	440	750	3	25	General Electric	KT	New
1	10	440	1500	3	25	General Electric	KT	New
3	15	440	1500	3	25	General Electric	KT	New
2	25	440	750	3	25	General Electric	KT	New
1	30	440	750	3	25	General Electric	KT	New
1	1	230	1150	Direct Current		General Electric	RC	New
1	⅛	110	1700	Direct Current		Fort Wayne	SD	New
1	¼	110	1800	1	60	General Electric	DSS	Used
1	7½	220	1800	3	60	General Electric	KT	Used
1	7½	220	1700	3	60	General Electric	CCL	Used

USED

Quan.	*Hp.*	*Volts*	*Speed*	*Phase*	*Cycle*	*Type*	*Make*
1	7½	220	1800	3	60	KT	Fort Wayne
1	7½	220	1700	3	60	CCL	Westinghouse
1	5	220	1420	3	25	CCL	Westinghouse

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"HONESTLY REBUILT" ELECTRICAL MACHINERY

The "Know how"—That "Mental Attitude" acquired thru years of honest endeavor and representation makes for "High Grade Product and Intelligent Service."

Your "Confidence" in our organization will not be misplaced.

SPECIAL OFFERINGS

200-kw., 3-ph. or 2-ph., 60-cy., 440/220-volt Westghse. Rev. Field, 200-r.p.m. Generator, direct conn., 20 x 21-in., 4-valve Horizontal Side Crank Auto Steam Engine, splash lubricating type, 5 years' service, carefully maintained. In first-class condition.

250-kw., 250-volt, D.C. Gen'l Electric, type D.L.C., compound Interpole, 600-r.p.m., 3-bearing, belt-driven Generator, 40-deg. machine. Condition like new.

200-kw., 250-volt, D.C. Westghse., 1150-r.p.m., com'd Interpole, 3-ph., 60-cy., 2300-volt Motor Generator Set, complete with D.C. Switchboard. "Elegant condition."

2—250-kw., 250-volt, D.C. Ridgway, 175-r.p.m. Generators, direct conn., 17 and 30 x 24, Ridgway Cross Comp'd, 4-valve, side crank Auto Steam Engines. In service 3 years. Like new.

250-kw., 125/250-volt, D.C. Allis-Chalmers, 750-r.p.m., 3-ph., 25-cy., 2300-volt synchronous Motor Generator Set and Switchboards.

200-kw., 250-volt, D.C. Allis-Chalmers, 750-r.p.m., 3-ph., 25-cy., 2300-volt Rotary Transformers and Switchboards.

300-kw., 3-ph., 25-cy., 2300-volt Allis-Chalmers, 167-r.p.m., with 20 and 34 x 18 Harrisburg Fleming Cross Comp'd Engine, Exciter and Switchboards.

—100-hp., 230-volt, D.C. General Electric, 290-r.p.m., 2-bearing, self-contained, 30-deg. Shunt Motors.

350-kw., 3-ph., 25-cy., 2300-volt Allis-Chalmers-750-r.p.m. Synchronous Motor, with Starting Panel.

DIRECT CURRENT GENERATORS

250-kw., 250-volt Gen. Elec., speed 600.
200-kw., 250-volt Northern, speed 385.
200-kw., 250-volt Triumph, speed 500.
150-kw., 250-volt National, speed 575.
2—125-kw., 125-volt Allis-Chal., speed 750.
110-kw., 250-volt Westghse., speed 675.
100-kw., 250-volt Allis-Chal., speed 550.
100-kw., 500-volt Western, speed 650.
75-kw., 250-volt Crocker-Wheeler, speed 1150.
50-kw., 250-volt Western, speed 780.
40-kw., 125-volt Western, speed 1150.
37½-kw., 250-volt Crocker-Wheeler, speed 900.
25-kw., 500-volt Western, speed 1350.
300-kw., 575-volt Gen. Elec., dir. conn. Erie Ball Steam Engine.
300-kw., 250-volt Western Elec., dir. conn. Quincy Auto Steam Engine.
200-kw., 500-volt Ridgway, dir, conn. Ridgway, 21 x 22-in. Steam Engine.
200-kw., 250-volt Westghse., dir. conn. Erie Ball Steam Engine.
150-kw., 250-volt Gen. Elec., dir. conn. Harrisburg Fleming Engine.
100-kw., 250-volt Westghse., dir. conn. Skinner Steam Engine.
75-kw., 250-volt Westghse., dir. conn. Erie Ball Steam Engine.
50-kw., 250-volt Crocker-Wheeler, dir. conn. Harrisburg-Fleming Engine.
25-kw., 125/250-volt Ft. Wayne, dir. conn. Sturtevant Vertical Engine.
25-kw., 250-volt Westghse., dir. conn. Erie Ball Steam Engine.

MOTOR GENERATOR SETS

500-kw., 125/250-volt, D.C., 3-ph., 60-cy., 6600-volt, A.C. Gen. Elec. Synch. Motor Generator.
300-kw., 275-volt, D.C., 3-ph., 25-cy., 2300-volt, A.C., Gen. Elec. Synch. Motor Generator.
200-kw., 500-volt, D.C., 3-ph., 60-cy., 2300-volt, A.C. Allis-Chalmers Synch. Motor Generator.
150-kw., 250-volt, D.C., 3-ph., 60-cy., 2300-volt, A.C. Gen. Elec., Synch. Motor Generator.
100-kw., 275-volt, D.C., 3-ph., 60-cy., 2300-volt, A.C. Gen. Elec. Rotary Converter.
75-kw., 250-volt, D.C., 3-ph., 60-cy., 440-volt, A.C., Crocker-Wheeler Induction Set.
50-kw., 250-volt, D.C., 3-ph., 60-cy., 440-volt, A.C., Westinghouse Induction Set.

ALTERNATING CURRENT MOTORS

2—1000-hp. Gen. Elec., 25-cy., slip ring, speed 300.
400-hp. Westghse., 60-cy., slip ring, speed 450.
300-hp. Gen. Elec., 60-cy., slip ring, speed 580.
250-hp. Gen. Elec., 60-cy., slip ring, speed 580.
225-hp. Gen. Elec., 60-cy., slip ring, speed 575.
200-hp. Westghse., 60-cy., slip ring, speed 600.
150-hp. Gen. Elec., 60-cy., Form L, speed 720.
150-hp. Gen. Elec., 25-cy., slip ring, speed 375.
100-hp. Burke, 60-cy., slip ring, speed 720.
75-hp. Burke, 60-cy., slip ring, speed 720.
42-hp. Gen. Elec., 25-cy., slip ring, speed 690.
50-hp. Westghse., 60-cy., slip ring, speed 690.
37-hp. Gen. Elec., 25-cy., slip ring, speed 690.
30-hp. Westghse., 60-cy., slip ring, speed 690.
450-hp. Westghse., 25-cy., sq. cage, speed 360.
300-hp. Westghse., 60-cy., sq. cage, speed 600.
200-hp. Westghse., 60-cy., sq. cage, speed 600.
200-hp. Westghse., 25-cy., sq. cage, speed 500.
200-hp. Westghse., 60-cy., sq. cage, speed 1140.
150-hp. Gen. Elec., 60-cy., sq. cage, speed 600.
100-hp. Allis, 60-cy., sq. cage, speed 1750.
100-hp. Burke, 60-cy., sq. cage, speed 514.
100-hp. Gen. Elec., 60-cy., sq. cage, speed 720.
75-hp. Westghse., 60-cy., sq. case, speed 690.
6—50-hp. Westghse., 60-cy., sq. cage, speed 850.
50-hp. Western, 60-cy., sq. cage, speed 1200.
4—35-hp. Westghse., 60-cy., sq. cage, speed 1120.
35-hp. Gen. Elec., 25-cy., sq. cage, speed 500.
35-hp. Western, 25-cy., sq. cage, speed 750.
6—25-hp. Westghse., 60-cy., sq. cage, speed 1200.

MOTOR DRIVEN PUMPS

5-in. Lea-Courtney Split Case Turbo Pump, with motor to suit.
5-in. Lea-Courtney Split Case, 2-stage Turbo Pump with motor to suit.
8-in. Worthington Split Case Volute Pump, with motor to suit.
8 x 10-in. Gould Vert. Triplex, with 25-hp., 3-ph 60-cy., 220-volt, G. E. Motor.

MISCELLANEOUS

2—2½-kva., 1-ph., 60-cy., 110-volt Crocker-Wheeler 1800-r.p.m. Generators.
4 15-kw., 3-ph., 60-cy., 220-volt Gen. Elec., 1800-r.p.m. Generators.
25-kw., 3-ph., 60-cy., 220-volt Sprague, 1200-r.p.m. Generator.
8—1-kw., 220-volt, D.C. Gen. Elec., 3-ph., 60-cy., 220-volt, 1800-r.p.m. motor generators.

PITTSBURGH'S ELECTRICAL CLEARING HOUSE — ESTABLISHED 1908

MILLER-OWEN ELECTRIC CO., Inc., LEXINGTON AVE. AND THOMAS BOULEVARD PITTSBURGH, PENNA.

We cordially invite inspection of our new Warehouse, Salesroom and Shop

BOILERS

Surplus stock taken over from the Du Pont Chemical Co. and other plants.

PRACTICALLY NEW

Used six Months to Three Years

Offered Subject to Any Inspection

No.	Size, Hp.	Make	Pressure, Lb.
9	600	Edge Moor (Ohio Standard)	200
13	600	Edge Moor	200
22	600	Edge Moor	160
1	813	Edge Moor (A. S. M. E.)	200
		Above located in du Pont Chemical Company's Plant at Hopewell, Virginia	
10	512	Stirling Class S No. 26	160
2	512	Stirling Class S No. 26	160
1	823	Stirling M-30 (A. S. M. E.)	200
2	550	Edge Moor	150
2	238	Edge Moor	150
4	231	Edge Moor (Ohio Standard)	150
1	199	Edge Moor	150
1	100	Smith HRT	100
1	50	Ames Locomotive	100

Above boilers located at du Pont Chemical Company's Plant, Carney's Point, N. J.

MISCELLANEOUS

No.	Size, Hp.	Make	ressure, Lb.
3	250	Heine	150
1	250	Heine	150
1	400	Stirling	150
2	400	Wickes	150
2	250	Wickes	165
2	250	Wickes	150
1	300	Wickes	150
1	225	Geary	150
1	250	B. & W.	125
2	210	B. & W.	125
1	347	B. & W.	160
1	200 U.S.A.	Scotch Marine	175
1	125	Scotch Marine	125
1	78 x 20	H.R.T.	135
8	72 x 18	H.R.T.	125
2	84 x 18	H.R.T.	100
2	66 x 16	H.R.T.	125
2	66 x 16	H.R.T.	80

STEEL STACKS

3—39 in. x 75 ft. 1—60 in. x 92 ft. 6—36 in. x 60 ft.
1—14 x 36 R. H. Corliss Engine.

We invite your inspection of any of the equipment we have in stock. Inspections can be made at any time. Quotations are made for prompt acceptance and subject to prior sale.

Let us handle your boiler requirements. We overcome high prices and slow deliveries on new boilers. Purchase now and take advantage of this stock which is moving rapidly.

Write or wire for specifications and quotations also when you have boilers for sale.

J. F. DAVIS, Phone Central 1494, 1122-24 Harris Trust Building, Chicago

114 Liberty Street New York, N. Y.

MACGOVERN & COMPANY INCORPORATED POWER MACHINERY

Three 320 KW. (400 Kva. 80% P. F.) GENERAL ELECTRIC
SNOW CRUDE OIL ENGINE UNITS

Immediate Delivery—Never been in service

We offer for immediate delivery the undernoted Alternating Current Crude Oil Engine Units, complete with all appurtenances. They have never been erected and are fully covered by the manufacturers' guarantees:

GENERATORS: 320 KW. (400 Kva. 80% p.f.) General Electric, type ATI-44, 480 volts, 3-phase, 60 cycle, 164 R.P.M.. direct connected to

ENGINES: Snow, 465 HP., horizontal, twin crude oil engine, 2 cycle, cylinders diam. 20 in., stroke 33 in.

EXCITERS: 14 KW. General Electric, type CVC, form AA, 125 volts, belt driven, 750 R.P.M.

SWITCHBOARD: With each unit there is a switchboard panel complete with all usual appurtenances.

AIR COMPRESSORS: With each unit there is the following:

1—3-cylinder 2-stage vertical belt driven Clayton air compressor, 200 lbs. pressure for starting engine.

1—12HP. horizontal, type IGECO single cylinder,4 cycle pump.

1—5 in. x 15 in. horizontal belt driven, duplex, double acting, piston fire pump for circulating water.

We shall be glad to furnish dimension prints and further information upon request

The above are only a few items from our large stock of Steam and Electrical Equipment, consisting of TURBO UNITS, RECIPROCATING UNITS, ROTARY CONVERTERS, MOTOR-GENERATOR SETS, BOILERS, CONDENSERS, PUMPS, ETC. Complete list will be gladly mailed upon request.
Send for our special lists of INDUCTION MOTORS, new and used, as we have too many to list mere.

BRANCH OFFICES:

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498 Union Arcade Building

SEATTLE, WASH.
L. C. Smith Building

MONTREAL, QUE.
285 Beaver Hall Hill

A No. 1 POWER APPARATUS
IMMEDIATE DELIVERY

A. C. UNITS

1—800 Kw. General Electric, Revolving Field Engine type Alternator, 60-cycle, 3-phase, 2300-v., direct connected to heavy duty Cross Comp. Corliss Engine.

1—400 Kw. Westinghouse, 60-cycle, 2- or 3-phase, 2200-v., D. C. to Cross Compound 4-valve Engine, 150 rpm.

1—400 Kw. Crocker-Wheeler Revolving Field Engine type Alternator, 60-cycle, 3-phase, 220-440-v., 225 rpm. No Engine.

2—300 Kw. Westinghouse R. F., Engine type Alternators, 25-30-cycle, 3-phase, 400-400-v., D. C. to Cross Compound Allis Corliss Engine.

1—300 Kw., G. E., 60-cycle, 3-phase, Alternator, 2300-v., D. C. at 150 rpm. to Tandem Automatic Engine.

1—325 Kva. Revolving Field, E. T. Alternator only, 60-cycle, 3-phase, 2300-v., 164 rpm.

1—650 Kw., Revolving Field, E. T. Alternator only, 60-cycle, 3-phase, 480-v., for direct connection at 170 rpm.

1—937 Kva. (750 Kw.), 60-cycle, 3-phase, 440-volt Revolving Field Alternator, direct connected to Erie City Lenze type. Practically new.

CONDENSERS

2—8000 Sq. Ft. Wheeler, Admiralty type, Surface Condensers, without Auxiliaries.
2—5750 Sq. Ft. Worthington, complete with all Fittings and Auxiliaries.

TURBINES

2—2000-3000 kw. Westinghouse Condensing or Non-Condensing Type Turbo Alternator Units, 60-cycle, 3-phase, 480, 550 or 2300-v., at 200 r.p.m., complete with 5700 sq. ft. Wheeler Condenser Outfit, or Westinghouse No. 11 Le Blanc Jet Condenser; in operation less than two years; condition A No. 1.

1—1500-2000-kw. capacity late type General Electric Horizontal, Condensing, 60-cycle, 3-phase, 2300-volt Turbo Alternator Unit. Practically new. Complete with Barometric Condenser and all Accessories.

2—1250 Kw. Westinghouse Condensing or Non-condensing or Bleeder type. 60-cycle, 3-phase, 480, 2300 or 11,000-v.

BOILERS

2—480 hp. Stirling butt joint construction, 160 lb. with stacks, stokers and all fittings.

6—420 hp. B. & W. Steel Header Water Tube Boilers, 150 lb. working pressure; equipped with Superheaters and Mechanical Stokers.

2—250-hp. Heinie, 115-140-lb.; complete plant, including Heater, Pumps, Piping and all fittings.

ENGINES

1—26 and 52 x 48 Heavy Duty Cross Compound Corliss Engine, with rope wheel.

1—24 and 50 x 48 Heavy Duty Cross Compound Corliss Engine, with belt wheel, 18-ft.

1—250 hp. Ideal Tandem Compound, 14 and 22 x 16 Automatic.

2—26 x 48 Hamilton Girder Frame Corliss, Wheel 20-ft. x 41-in.

1—22 x 48 Harris Left Hand Corliss, Wheel 16-ft. x 32-in.
HEAVY DUTY CORLISS, AUTOMATIC AND FOUR VALVE ENGINES, RANGING IN SIZES FROM 100 TO 1500 HP. CAPACITY.

OIL ENGINE UNITS

1—650 Kw. Revolving Field E. T. Alternators, 60-cycle, 3-phase, 480-v., D. C. to Vertical Gas Engine.
2—300 Kw., 60-cycle, 3-phase Revolving Field E. T. Alternators, D. C. to Vertical Diesel Engines.
1—400 Kva., 60-cycle, 3-phase Revolving Field Alternator, D. C. to Horizontal Diesel Engine.
2—300 Kw., E. T. Revolving Field Alternators, 250-v., D. C. to Vertical Diesel Engines.
SEVERAL BELTED GAS AND CRUDE OIL ENGINES RANGING IN SIZE FROM 100 TO 800 KW.

BELTED D. C. UNITS

2—400 Kw., 250-v., M. P., 3 Bearing Westinghouse Generators; 375 rpm., with suitable Corliss Engines.
150, 200, 250 and 300 Kw. BELTED MULTIPOLAR GENERATORS WITH OR WITHOUT CORLISS OR AUTOMATIC ENGINES.

PAUL STEWART & COMPANY, First National Bank Bldg., Cincinnati, Ohio
Long Distance Phone No. Maine 2662.

Fractional Horse Power Motors

SINGLE PHASE 60-CYCLE

IN STOCK AND ON ORDER—ALL NEW

Quantity	Hp.	Make	Type	Volts	Speed
100	1/30	General Electric	SA	110	1725
400	1/6	Westinghouse	CAH	110	1725
3000	1/4	Westinghouse	CAH	110	1725
200	1/4	Westinghouse	CAH	220	1725
500	1/4	Robbins & Myers	P18	110	1750
50	1/4	Wagner	7W6BA	110/220	1750
100	1/3	Wagner	13B	110	1750
100	1/2	Robbins & Myers	P19	110	1750
50	1/2	General Electric	SA	110	1800
25	1/2	Emerson	.....	110	700
50	1/2	Robbins & Myers	P19	220	1750
10	3/4	Westinghouse	CA	110	1725
12	3/4	Westinghouse	CA	110	1140
3	3/4	Westinghouse	CA	220	1140

REPULSION-INDUCTION TYPE 110/220 VOLTS—60 CYCLE—SINGLE PHASE

WAGNER, CENTURY AND WSTGHS.

Quantity	Hp.	Speed
50	1	1750
12	1	1160
10	1-1/2	1750
10	1-1/2	1160
50	2	1750
15	2	1160
12	2	1160
60	3	1750
12	3	1160
20	5	1750
10	5	1160

D. C. SHUNT & COMPOUND WOUND

50	1/8	Diehl	1725
100	1/6	Diehl	1725
300	1/4	Diehl	1725
300	1/4	R. & M.	1750
50	1/4	R. & M.	1150
60	1/2	Gen. Elec.	1800
50	1/2	Westinghouse	1725
50	3/4	Westinghouse	1725
40	1	Westinghouse	1725
20	1	Westinghouse	1725
8	1	Gen. Elec.	1150
10	2	Gen. Elec.	1150
6	2	Westinghouse	1725
4	3	Westinghouse	1725
6	3	Gen. Elec.	1150
10	5	Gen. Elec.	1150

BIG SHIPMENTS OF DIRECT CURRENT, 2 AND 3 PHASE, 60 CYCLE, 220 VOLTS RECEIVED. 300—12-16 in. VENTILATING AND EXHAUST FANS IN STOCK.

Reliable Electric Motor Co., Inc., 165-167 Grand St., New York City

LARGE EQUIPMENT Ready For Immediate Delivery

ALTERNATING CURRENT, DIRECT CONNECTED SETS

1—450 Kva., 3-phase, 60-cycle, 550-volt, Crocker-Wheeler generator, direct connected to horizontal cross compound Erie City Lentz engine, size 15½ x 26 x 18, 200 r.p.m. Complete with all parts ready to operate; practically new. Installed in 1912.

1—240 Kw., 3-phase, 60-cycle, 600-volt, can be reconnected to 2,300 volts or lower voltage, 200 r.p.m., General Electric, type ATB, direct connected to horizontal Harrisburg Ideal Tandem Compound engine.

1—300 Kw., 3-phase, 25 cycle, 380-volt General Electric, revolving field, type ATB generator, 107 r.p.m., to horizontal cross compound Brown engine, in splendid condition.

DIRECT CURRENT, DIRECT CONNECTED SETS

1—300 Kw., 550-volt, can be reconnected to 250 volts, General Electric, 8 pole, form H generator, amperes 545, 105 r.p.m., full commutator, direct connected to horizontal cross compound Green engine, splendid condition.

ROTARY CONVERTERS

2—300 Kw., 3-phase, 25-cycle, 600-volt, D. C. operation, complete with transformers.

LARGE HEAVY DUTY CORLISS ENGINE

1—26-in. x 48-in. heavy duty Allis Corliss engine, in splendid shape.

LARGE ALTERNATING CURRENT BELTED GENERATORS

1—300 Kw., 3-phase, 60-cycle, 2,300-volt Allis-Chalmers, revolving field, 600 r.p.m., 3 bearing generator, 35 degree rated machine, good for 400 Kva.

1—200 Kw., 3-phase, 60-cycle, 2,300-volt, type ATB, General Electric, 3 bearing generator, 600 r.p.m.

2—100 Kw., 3-phase, 60-cycle, 2,300 volt, 900 r.p.m. General Electric, type ATB generator.

LARGE ALTERNATING CURRENT MOTORS

1—300 Hp. 3-phase, 60-cycle, 550-volt, 600 r.p.m. Crocker-Wheeler motor.

3—150 Hp., 3-phase, 60-cycle, 550-volt, 720 r.p.m., type M, new 40 degree rise General Electric, slipring motors.

2—150 Hp., 3-phase, 60-cycle, 220-volt, 586 r.p.m. Westinghouse, type CS motors.

1—200 Hp., 3-phase, 60-cycle, 220-volt, 600 r.p.m., new, Western Electric, form M motor.

1—75 Hp., 3-phase, 60-cycle, 440-volt, 720 r.p.m., Western Electric, form K motor.

2—100 Hp. 3-phase, 60-cycle, 220-volt, 900 r.p.m., form K, new General Electric 40 degree rise motors.

1—220 Hp., 3-phase, 60-cycle, 220-440 volt, General Electric, type M, 450 r.p.m., slipring motor.

DIRECT CURRENT BELTED GENERATOR

1—450 Kw., 250-volt, 8 pole, C & C direct current generator.

LARGE ALTERNATING CURRENT GENERATORS FOR WATERWHEEL DRIVE OR SYNCHRONOUS MOTOR FOR DIRECT CONNECTION

2—550 Kw., 3-phase, 60-cycle, 480-volt, 171 r.p.m. General Electric, revolving field, 85% power factor.

DIRECT CURRENT—3-WIRE TURBINE UNIT

1—150 Hp. De Laval Turbine, direct connected to 100 Kw., 125/250 volts, direct current Sprague generator.

SMALL ALTERNATING CURRENT TURBINE SET

1—100 Kw., 3-phase, 60-cycle, 240-volt, 3,600 r.p.m., General Electric generator, type ATB, form P to Curtiss turbine.

JOSEPH MYERSON, 411 Atlantic Ave., Boston, 9, Mass.

STANDARD ELECTRIC & ELEV. CO. INC. BALTIMORE

Main Office: 118 E. PRATT STREET Phone: St. Paul 7720

ELECTRIC MOTORS IN STOCK READY FOR IMMEDIATE DELIVERY

Don't delay your plans waiting on long factory promises. Phone, wire, write.

MOTORS—2-Phase, 60-Cycle, 220-Volt

1	2	G. E.	KQ	1200	U	Stock
1	7½	Fidelity	AP	1750	U	6/20
3	15	Westghse.	CS	1800	N	Stock
2	20	Allis-Chal.	AN	1800	N	Stock
1	20	G. E.	M	1800	U	Stock
4	25	Allis-Chal.	AN	1800	N	Stock
2	40	Allis-Chal.	AN	1800	N	Stock
4	50	Allis-Chal.	AN	1800	N	Stock
1	100	Allis-Chal.	AN	1800	N	Stock
13	2	C.-W.	.....	1200	N	Stock
9	¼	C.-W.	.....	1800	U	Stock
3	1	Wagner	.....	1800	U	Stock
2	1	Wagner	.....	1140	U	Stock
25	2	C.-W.	.....	1200	U	Stock
6	3	C.-W.	.....	1200	U	Stock
4	3	C.-W.	.....	1800	U	Stock
1	7½	C.-W.	.....	1200	U	Stock
1	10	C.-W.	.....	1200	U	Stock
2	15	C.-W.	.....	1200	U	Stock
2	15	R.-M.	.....	1200	U	Stock
2	15	Westghse.	.....	1200	U	Stock
1	15	Westghse.	.....	1800	U	Stock
1	15	R.-M.	K	900	U	Stock
1	125	Westghse.	CCL	450	U	Stock
1	150	Westghse.	CCL	514	U	Stock

MOTORS—2-Phase, 60-Cycles, 550-Volts

2	60	W. E.	KQ	1200	N	Stock
4	75	W. E.	KQ	1200	N	Stock
2	150	Westghse.	CW	600	N	Stock
1	300	G. E.	IQ3Brg.	514	U	Stock
1	115	Westghse.	CCL	400	U	Stock

MOTORS—3-Phase, 60-Cycle, 220 and 440-Volt

1	1	G. E.	KT	1800	U	Stock
1	1	Allis-Chal.	AN	1200	N	Stock
1	1	Allis-Chal.	AN	1800	N	Stock
1	2	Allis-Chal.	AN	1200	N	Stock
2	2	Allis-Chal.	AN	1800	N	Stock
2	2	Allis-Chal.	AN	1200	N	Stock
2	3	Allis-Chal.	AN	1200	N	Stock
4	3	Allis-Chal.	AN	1800	N	Stock
2	3	Allis-Chal.	AN	1200	N	Stock
3	5	Allis-Chal.	AN	1200	N	Stock
2	5	Allis-Chal.	AN elev.	770	N	Stock
8	5	Allis-Chal.	AN	1800	N	Stock
2	5	Allis-Chal.	AN	1200	N	Stock
4	7½	Allis-Chal.	AN	1200	N	Stock
1	7½	G. E.	KT	1200	U	Stock
3	10	Allis-Chal.	AN	900	N	6/28/20
4	10	Allis-Chal.	AN	1200	N	Stock
2	10	W. E.	KT	1200	U	Stock
3	15	Allis-Chal.	AN	1200	N	Stock
2	15	Allis-Chal.	AN	900	N	Stock
1	15	Allis-Chal.	ANY	900	N	Stock
1	15	Allis-Chal.	ANY	1200	N	Stock
2	15	Allis-Chal.	AN	900	N	Stock
1	20	F.-M.	KBV	1200	N	Stock
2	20	Allis-Chal.	AN	1200	N	Stock
1	20	Allis-Chal.	ANY	1200	N	Stock
2	20	Allis-Chal.	ANY	900	N	Stock
1	20	Allis-Chal.	AN	900	N	Stock
1	20	Century ind.	rest start	865	N	Stock
1	25	Allis-Chal.	AN	1200	N	Stock
6	25	Allis-Chal.	AN	900	N	Stock
1	25	Westghse.	CS	685	U	Stock
1	25	G. E.	KT	900	U	Stock
3	30	Allis-Chal.	ANY	900	N	Stock
1	30	Allis-Chal.	AN	1200	N	Stock
2	30	Westghse.	CCL	900	U	Stock
1	30	Allis-Chal.	AN	900	N	Stock
1	35	Westghse.	CS	900	U	Stock
1	35	C.-W.	Sq. cage	860	N	Stock
1	40	Westghse.	CW	1200	N	Stock
4	40	Allis-Chal.	AN	1200	N	Stock
3	40	Allis-Chal.	ANY	900	N	Stock
1	40	Allis-Chal.	AN	900	N	Stock
1	45	G. E.	K	720	N	Stock
1	50	Allis-Chal.	AN	720	N	Stock
1	50	Allis-Chal.	AN	1200	N	Stock
2	50	Allis-Chal.	AN	1800	N	Stock
1	50	Allis-Chal.	ANY	900	N	Stock
1	60	G. E.	K	1200	N	Stock
1	75	Allis-Chal.	AN	900	N	Stock
1	75	G. E.	K	1200	N	Stock
1	150	Westghse.	CW	600	N	Stock
1	200	Westghse.	CW	600	N	Stock

MOTORS—3-Phase, 60-Cycle, 550-Volt

1	5	Allis-Chal.	AN	1800	N	Stock
3	7½	Allis-Chal.	AN	1800	N	Stock
3	15	Westghse.	CS	1800	N	Stock
2	20	Allis-Chal.	AN	1800	N	Stock
1	20	G. E.	M	1800	U	Stock
4	25	Allis-Chal.	AN	1800	N	6/28/20
2	40	Allis-Chal.	AN	1800	N	Stock
4	50	Allis-Chal.	AN	1800	N	6/28/20
1	75	G. E.	I	1200	N	6/28/20
2	100	W. E.	KT	1800	N	Stock
1	100	Allis-Chal.	AN	1800	N	Stock
2	150	Westghse.	CW	600	N	Stock
1	115	Westghse.	CCL	450	U	Stock
1	125	Westghse.	CCL	600	U	Stock
1	150	Westghse.	CCL	600	U	Stock
1	175	Westghse.	CCL	415	U	Stock

MOTORS—3-Phase, 60-Cycle, 2200-Volt

2	150	Westghse.	CW	600	N	Stock

MOTORS—Single Phase, 25-Cycle

No.	Hp.	Make	Type	Volts	Rpm.		Avail.
1	¼	Century	R.S.	110-220	750	N	Stock

MOTORS—2-Phase, 25-Cycle, 220-Volt

No.	Hp.	Make	Type	R.p.m.		Avail.
1	30	Allis Chal.	AN	750	U	Stock
2	50	Westghse.	CW	250	N	Stock
1	125	G. E.	IQ3Brg	214	U	Stock

MOTORS—3-Phase, 25-Cycle, 220 and 440-Volt

1	1	Westghse.	CSA	750	N	Stock
3	1	Allis-Chal.	AN	1500	N	Stock
1	2	Allis-Chal.	AN	1500	N	Stock
2	2	Allis-Chal.	AN	750	N	Stock
2	3	Allis-Chal.	AN	1500	N	Stock
2	5	Allis-Chal	AN	1500	N	Stock
2	5	Allis-Chal.	AN	750	N	Stock
3	7½	Westghse.	CS	750	N	Stock
1	7½	Allis-Chal.	AN	750	N	Stock
2	10	Allis-Chal.	AN	750	N	Stock
1	15	Allis-Chal.	AN	750	N	Stock
1	15	G. E.	K	300	N	Stock
4	20	Allis-Chal.	AN	750	N	Stock
1	30	G. E.	K	500	N	Stock
2	40	W. E.	KT	725	N	Stock
1	50	Westghse.	CW	250	N	Stock
4	50	W. E.	KT	725	N	Stock
1	150	W. E.	KT	750	N	Stock
2	150	W. E.	M	500	N	Stock

MANUFACTURERS, ENGINEERS, CONTRACTORS, JOBBERS

Reliable—POWER PLANT MACHINERY

DIRECT CURRENT GENERATORS

Belted and Direct Connected

1—7-kw. Jantz & Leist, 125-volt, 1000-r.p.m., compound wound belted type Generator.
1—17½-kw. Triumph, 125-volt, compound wound, enclosed type Generator, direct connected to an 8 x 8 Troy vertical automatic engine on same base.
2—50-kw. each, 125 volt Westinghouse, 400-ampere, 575-r.p.m., direct current, compound wound Generators, each direct connected to a 10 x 12 Erie Ball enclosed type automatic right-hand engine, with oiling system and accessories.
1—75-kw. General Electric, 125-volt, 600-ampere, 275-r.p.m., compound wound, direct current Generator, direct connected to a 14½ x 14 Russell left-hand, automatic engine with accessories.
1—100-kw. Triumph, 125-volt, 675-r.p.m., compound wound, belted type Generator.
1—100-kw. Allis-Chalmers, 125-volt, direct current, compound wound Generator, direct connected to a 14 x 16 Ball automatic enclosed type, left- hand engine, with accessories and switchboard. (Will also furnish for 250-volt.)
2—150-kw. Milwaukee Electric Company, 250-volt, direct current, compound wound Generators, each direct connected to an 18 x 16 Harrisburg automatic piston valve engine with accessories and switchboard.

A. C. GENERATORS

Belted and Direct Connected

1—800-kw. Allis-Chalmers, 3-phase, 60-cycle, 480-volt alternator, direct connected to a 26 x 44 x 48 cross compound, Allis-Chalmers Corliss Engine.
1—500-kw. General Electric, 3-phase, 60-cycle, vertical Turbo Generator Set with condenser and accessories.
1—125-kw. Western Electric, 3-phase, 60-cycle, 240-volt, 257-r.p.m. revolving field, A.C. Generator, direct connected to a 15 x 16 Skinner automatic, enclosed type, right hand, self-oiling Engine, with belted exciter, switchboard and instruments.
1—90-kva. Electric Machinery Company, 3-phase, 60-cycle, 2200-volt, 1200-r.p.m., revolving field belted type alternator.

DIRECT CURRENT MOTORS

No.	Hp.	Make	Volts	R.p.m.
1	50	Rebuilt Allis-Chalmers	250	800
1	30	Rebuilt Northern	220	600
1	10	Rebuilt Triumph	250	1100
1	10	Rebuilt Triumph	220	1150
1	10	Rebuilt Jantz & Leist	220	750
1	8	Rebuilt Jantz & Leist	110	750
1	7½	Rebuilt Jantz & Leist	220	800
1	7½	Rebuilt Interpole	220	550-1100
1	5	Rebuilt Triumph	115	1300
1	5	Rebuilt Triumph	220	1300
1	5	Rebuilt Fairbanks-M	220	1175

BOILERS

2—400-hp. Sterling, 160-lb. pressure.
2—250-hp. Sterling, 150-lb. pressure.
1—200-hp., 84 x 18, high pressure, return tubular.
4—150-hp., 72 x 18, high pressure, return tubular.
1—125-hp., 72 x 16, high pressure, return tubular.
3—100-hp., 66 x 16, high pressure, return tubular.
2—100-hp., 66 x 16, horizontal, return tubular.
1— 80-hp., 60 x 16, horizontal, return tubular.
1— 60-hp., 54 x 14, horizontal, return tubular.
2— 50-hp., 48 x 14, horizontal, return tubular.
1— 30-hp., 44 x 10, high pressure, return tubular.
1— 20-hp., 36 x 101, new Ohio standard, vertical.
1— 15-hp., 36 x 83, new Ohio standard, vertical.
1— 10-hp., 30 x 83, new Ohio standard, vertical.
1— 8-hp., 30 x 68, new Ohio standard, vertical
1— 5-hp., 24 x 65 new Ohio standard, vertical

MOTOR GENERATOR SETS

1—Used 100-kw. Triumph, 125-volt, 800-ampere, compound wound, direct current Generator, direct connected to a 150-hp. Westinghouse, 3-phase, 60-cycle, 2200-volt, 720-r.p.m., squirrel cage induction motor with rheostat and starter.

MOTORS

Alternating Current, 3-Phase, 60-Cycle Squirrel Cage and Slip Ring

No.	Hp.		Make	Volts	R.p.m.
2	10	Used	G. E.	220	1200
2	10	New	Triumph	220	1800
1	15	Used	Cr.-Wh.	440	850
1	15	Used	G. E.	220	850
2	20	New	G. E.	440	1800
1	25	New	G. E.	440	1800
1	25	Used	G. E.	220	600
1	30	New	G. E.	220	1800
1	30	New	G. E.	220	1200
1	30	New	G. E.	220	900
1	40	New	G. E.	220	1800
2	40	New	G. E.	220	1200
5	40	New	G. E.	440	1200
1	40	New	G. E., slip ring	440	1200
1	50	New	G. E.	220	1800
2	50	New	G. E.	220	900
2	60	New	G. E.	220	900
3	75	New	G. E.	220	1200
2	75	New	G. E.	220	900
1	75	Used	Wstgh.	440	700
1	75	Used	Wstgh.	220	1120
1	75	New	G. E., slip ring	440	900
1	100	Used	Wstgh.	220	1200
3	100	New	G. E.	220	900
1	150	Used	Wstgh.	2200	720

STEAM ENGINES

1—17 x 34 x 48 Hamilton cross compound, heavy duty Corliss.
1—16 x 34 x 48 Hamilton tandem compound, heavy duty Corliss.
1—18 x 36 Hamilton heavy duty Corliss.
1—18 x 30 Allis heavy duty Corliss.
1—18 x 24 Atlas automatic four valve.
1—14 x 30 Hamilton heavy duty Corliss.
1—14 x 24 Houston, Stanwood & Gamble slide valve.
1—12 x 16 Chandler & Taylor slide valve.
1—12 x 12 Erie City automatic.
1—11 x 15 Erie automatic.
1—11 x 12 Skinner automatic.
1—10 x 12 Brownell slide valve.
1— 9 x12 Chandler & Taylor slide valve
1— 8 x 10 Brownell slide valve.
1— 7 x 7 American Blower piston valve.
1— 4 x 5-hp. Clark vertical.

THE RANDLE MACHINERY COMPANY *Established 35 Years*

Located ONLY at **1822 POWER ST., CINCINNATI, OHIO**

General Electric Motors

ALTERNATING CURRENT
SQUIRREL CAGE

NEW AND USED

Hp.	Speed	Volts 220	440
½	1200	...	1
2	1200	1	...
5	900	...	2
10	1800	3	...
15	1800	...	1
15	900	2	...
20	900	1	...
25	1800	...	1
25	1200	3	2
25	900	3	...
30	1200	4	7
30	900	4	1
40	1200	4	7
40	900	4	5
40	720	1	...
50	1200	3	11
50	900	6	5
60	1200	...	2
60	900	1	...
75	1200	...	2
75	900	...	2
75	720	2	...
100	720	...	2
200	450	...	1

SLIP RING

50	1200	1	...
200	600	...	1
200	600	(2200-V.)	1

THE ELLIOTT ELECTRIC CO.
Cleveland

For Quick Sale! *Ready Now!*

GENERATORS AND MOTORS

1—150 kw. Triumph, 220 volt D.C. Generator, direct connected to 16-in. x 21-in. Chuse Corliss Valve Engine.
1—150 kw. Crocker-Wheeler, 115 volt D. C. Generator, belted type.
1—150-hp. Fairbanks-Morse Motor, 440-volt, 3-phase, 60-cycle.
1—75-hp. General Electric Motor, 440-volt, 3-phase, 60-cycle.
4—7½-hp. General Electric, 220-volt, 3-phase, 60-cycle.
1—200-hp. Crocker-Wheeler, 115-volt, D.C. Motor.
1—10-hp. Western Electric, 110-volt D.C. Motor.
2—6-hp. C. & C., 110-volt D.C. Motors.
1—30-hp. Northern, 110-volt, D.C. Motor.
1—17-hp. Otis, 110-volt, D.C. Motor.
1—60 kw. Triumph, 125-volt, D.C. Generator, belt driven.
1—20 kw. Burke, 125-volt, D.C. Generator, direct connected to Erie Steam Engine.
1—15-hp. Western, 220-volt, D.C. Motor.
1—10-hp. Western, 115-volt, D.C. Motor.
1—10-hp. Bullock, 120-volt, D.C. Motor.
2—6-hp. Bullock, 120-volt, D.C. Motor.
1—200-hp. Crocker-Wheeler, 115-volt, D.C. Motor, speed 500.

ROTARY CONVERTER

1—300 kw. General Electric Rotary Converter, 25-cycle, 600-volt.

COPPER WIRE

10,000 ft., 400,000 C.M. Stranded Bare Copper Wire.
50,000 ft., 350,000 C.M. Stranded Bare Copper Wire.
10,000 ft. of No. 4-0 Grooved Copper Trolley Wire.
1,500,000 ft. No. 0 to No. 14 W.P.
500,000 ft. No. 00 to No. 14 R.C.

Send for our complete list of machinery, No. 308

HARRIS BROTHERS CO.
1430 W. 35th STREET CHICAGO, ILL.

ALTERNATING CURRENT MOTORS

Hp.	Make	Volts	Type	Speed
100	Westghse.	220	C	690
100	Cr.-Wh.	220-440	Slip ring	900
2— 50	Westghse.	220-440	C.C.L.	900
2— 50	Gen. Elec.	220	K.Q.	900
50	Cr.-Wh.	220-440	.....	690
3— 25	Wagner	220-440	B.P.	1160
30	Westghse.	220	C.S.	1160
40	Westghse.	220	C.S.	900
20	Gen. Elec.	220	K.Q.	900

MOTOR GENERATORS

2—50-hp. C.C.L. Westghse. to 35-kw. S.K. Westghse., 220-volt.
15-hp. C.C.L. Westghse. to 10-kw. S. Westghse., 110-volt.
35-kw., 110-volt Gen. Elec. Generator to DeLaval turbine.

LARGE STOCK DIRECT CURRENT MOTORS

COMPLETE PLANTS BOUGHT AND SOLD

WE SOLICITE YOUR INQUIRIES WHEN IN THE MARKET TO BUY OR SELL

R. SCHEINERT COMPANY
123-25 N. Third Street, Philadelphia, Pa.

MOTORS

60 cycle, 2 and 3 phase

2200 VOLTS

1— 50 hp., Westinghouse, type CCL, 690 r.p.m.

550 VOLTS

1—250 hp., Allis-Chalmers, 440 r.p.m. Slip ring.

220/440 VOLTS

1—200 hp., Westinghouse, type C, 580 r.p.m.
1—200 hp., Crocker-Wheeler, 870 r.p.m.
3—100 hp., Crocker-Wheeler, 1800 r.p.m.
1—100 hp., Crocker-Wheeler, 850 r.p.m.
2—100 hp., Crocker-Wheeler, 720 r.p.m. Slip ring.
1— 75 hp., Westinghouse, type CCL, 850 r.p.m.
1— 75 hp., Westinghouse, type CCL, 1120 r.p.m.
1— 75 hp., Crocker-Wheeler, 1160 r.p.m.
1— 50 hp., General Electric, type I, 600 r.p.m.
1— 50 hp., Crocker-Wheeler, 720 r.p.m.
1— 50 hp., Fairbanks-Morse, 720 r.p.m.
1— 50 hp., Fairbanks-Morse, 1200 r.p.m. Slip ring.
1— 40 hp., Crocker-Wheeler, 865 r.p.m.

NEW SINGLE-PHASE CENTURY, 110-220 VOLTS

Prices f.o.b. Pittsburgh

3—3 hp., 1165 r.p.m., $238 each.
5—1½ hp., 1165 r.p.m., $157 each.
2—1½ hp., 1750 r.p.m., $135 each.
5—1 hp., 1165 r.p.m., $135 each.
2— ¾ hp., 1165 r.p.m., $114 each.

Also a stock of various smaller sizes in A.C. and 110, 220 and 500 volts D.C.

Motor-generators — Turbo-generators — Direct connected units—Gas Engines—Boilers—Complete Plants—Ice Machines.

W. A. CARRELL COMPANY
211-213-215 Second Ave., Pittsburgh, Pa.

IMMEDIATE DELIVERY FROM STOCK

Quan.	*Hp.*	*Make*	*Type*	*Speed*	*Volts*	*Phase*
40	3	General Electric	KT	1800	220	3
20	5	General Electric	KT	1800	220	3
5	5	General Electric	KQ	1800	220	2
5	7½	General Electric	KQ	1150	220	2
1	50	General Electric	M	900	440	3
1	50	General Electric	M	600	440	3
1	50	General Electric	M	1200	220	3
1	40	Westinghouse	CW	1200	220	3
1	75	General Electric	M	720	220	3
1	75	General Electric	ITC	900	220	3
2	75	Westinghouse	CW	900	220	3
1	80	General Electric	CLB	800	220	D. C.

1—50-kw. Burke, three-wire, direct current, 950-r.p.m., 125-250-volt.
1—80-hp., DLC, 750-r.p.m. G. E., 220-volt. 1—35-kw., CLB, 1050-r.p.m. G. E., 125-volt.
1—100-hp. Crocker-Wheeler, 1200-r.p.m., 220-volt.

MONARCH ELECTRIC MOTOR CO., 166 Centre St., New York City

Yep!—

We have the best mechanics in the country to repair or rebuild electrical equipment.

Ready to go anywhere—and at any time too!

I. R. NELSON CO.
BOND STREET, NEWARK, N. J.

For Sale and Immediate Delivery

Two Hydro-Electric Units
each consisting of

One I. P. Morris, 5400 H.P. vertical shaft turbine, 300 R.P.M., under 130 ft. head. Volute casing, shaft, bearings, governor, complete with pumping system and hydraulically operated pivot valves.

One General Electric Co. ATP 10-pole, 4500 KVA, 3-phase, 25-cycle, 11,000 V., 300 R.P.M., continuous rated (3825 KW 85% power factor) vertical type, water wheel driven generator, arranged for direct connection. Generator furnished with upper and lower guide bearings, with G.E. spring thrust bearing with cooling coils, base, shaft, with forged couplings, stairway, with MPC 6-pole, 80 KW, 300 RPM, 125 V compound wound direct connected exciter.

Switchboard complete with all necessary instruments, voltage regulators, synchronizing apparatus, etc., also 5 feeder panels.

Full description, drawings and specifications will be furnished to the purchaser.

Engineering Department

International Paper Company
30 Broad St., New York

HAROLD R. WILSON MACHINERY CO.
Electric and Steam Machinery Second Hand
Federal Reserve Bank Building, ST. LOUIS, MO.

DIRECT CONNECTED A.C. UNITS (60 CYCLES)

Kw.	Make	Volts	Ph.	Engine Description
2000	G. E.	2300	2 or 3	Curtis St. Turb. Hor.
1250 (2)	G. E.	2300	3	Curtis Hor. Steam Turbine
1000	Wghse.	2200	2 or 3	Allis C.C. Corliss Engine
1000	Allis	2300	3	Allis St. Turbine
850	Allis	2300	3	30x48 Allis-Corliss
750	G. E.	2300	3	25&42x30 Lentz C.C.
500 (2)	Allis	2300-600	3	Allis Hor. Steam Turbine
500	G. E.	2300	3	McI. & Seymour 18x38x30 V. C.C.
300	G. E.	2300	2 or 3	14&30x42 Cross Compound
300	G. E.	Any	3	Cross Comp. Corliss
300	G. E.	440	3	St. Louis Corliss 22x36
288 (2)	G. E.	2300	3	14&30x18 Harrisburg 4-valve T.C.
200	Nat.	2300	2 or 3	14&26x36 Hamilton Cor. C.C.
187	Wghse.	2300	3	Westinghouse-Parsons Steam Turbine
150	Ft. Wa.	2200	3	14&22x19 Chuse 4-valve
125	Ft. Wa.	2300	3	15×16 Erie Ball
100	G. E.	2300	3	toCurtis Turb., 1 Cond., 1 Non-Cond.
100 (2)	Wghse.	2300	3	Harrisburg 4-valve, simple

Other Sizes—Also A.C. and D.C. Belted Dynamos, Motors.
ENGINES—BOILERS—ROTARIES—ELECTRIC CARS, Etc.
We probably have just what you require—Try us.

GENERAL ELECTRIC MOTORS
DIRECT CURRENT—New and Used

Hp.	Speed	Volts	Qu.
½	1700	115	1
½	1700	230	1
1	1700	115	2
1	1700	230	1
1	1150	230	1
2	1700	230	3
3	1700	230	2
5	1700	230	1
7½	1700	230	1
20	1150	230	1
20	250/1000	230	1
25	1250	550	2

THE ELLIOTT ELECTRIC CO., Cleveland

Immediate Delivery—First Class Condition

1—375-kw. General Electric (Fort Wayne) type TRE alternator, 3-phase, 60-cycle, 2200 volts, 164 r.p.m.; direct connected to Ball cross-compound, non-condensing, 4-valve engine, non-release, 18 x 34 x 24; complete with exciter and generator panel. Can be reconnected for either 480 or 240 volts. Immediate shipment.

1—Laidlay-Dunn Air Compressor, duplex, 11 x 20 x 15 x 18; displacement 1100 cu. ft. per minute at 150 r.p.m.; steam pressure, 125 lbs.; air pressure, 80 lbs. Immediate shipment.

1—Laidlaw Compound, Non-Condensing Pump, cross-connected 12 x 22 x 7½ x 18. Will pump 750 gals. per minute at 90 r.p.m. against 120-lb. head. Delivery July 1.

1—Platte Iron Works duplex pump, compound, 10 x 18 x 10 x 18. Will pump 18 gals. per minute at 45 r.p.m. against 120-lb. head. Delivery July 1st.

1—30-hp. Allis-Chalmers Motor, 370-volts, 720 r.p.m., 3-phase, 25-cycle, with rails, pulley and compensator.

1—16-hp. Western Electric Slip Ring Motor, 3-phase, 60-cycle, 220 or 440 volts, 900 r.p.m.; with base, pulley, controller and resistance for 50% speed reduction for continuous service. Stock shipment.

1—50-hp. General Electric Form "L" internal resistance wound rotor Motor, 3-phase, 60-cycle, 220 or 440 volts, 1200 r.p.m.; with base and pulley. Stock shipment.

We also have many other machines to offer. Advise us your requirements. Let us quote on your wants.

THE ELECTRIC SERVICE CO., 212 Walnut St., Cincinnati, Ohio

A. C. GENERATORS

3-Ph. 60-Cy. 2300-V.

1—2250 kw., 900 r.p.m., 2300-v., Vert. Turbine, G.E.
1—1000 kw., 1200 r.p.m., 2300-v., Vert. Turbine, G.E.
1—500 kw., 1800 r.p.m., 2300-v., Vert. Turbine, G.E.
1—100 kw., 900 r.p.m., 2300-v., Belted, G.E.
1— 75 kw., 600 r.p.m., 2300-v., Belted, G.E.
1— 50 kw., 1200 r.p.m., 2300-v., Belted, A.C.

Write for Complete Stock Summary.

Phoenix Utility Co., 71 Broadway, New York

2 MOTOR GENERATOR SETS

100-kw. Westinghouse, 125-v., 750-r.p.m., D.C. compound wound, type SK. generators direct connected to Westinghouse, 150-hp., 3-phase, 25-cycle, 750-r.p.m. revolving field synchronous motors.

NATHAN KLEIN & CO.
Howard and Centre Streets, New York

BOILERS

ACTUAL USE LESS THAN A YEAR

2—250 HP. B & W Water Tube, 150 lb. W. P.
3—150 HP. Brownell H. R. T. 150 lb. W. P. Dbl. Butt Strapped Quadruple Riveted Independent Suspension.

MOTORS

3 ph., 60 cycle, 220-440 volts

1—75 HP. G. E. Type K, 720 r.p.m.
2—50 HP. G. E. Type K, 900 r.p.m.
2—35 HP. G. E. Type K, 1200 r.p.m.
4—25 HP. Westinghouse, C. S. 1200 r.p.m
8—7½ HP. Westinghouse, C. S. 1200 r.p.m.
1—20 HP. Wagner Slip Ring, 2 phase, 60 cycle, 220 v., 1800 r.p.m.

A. C. and D. C. Motors ¼ to 50 HP.

DELTA EQUIPMENT CO.
140-142 N. Third Street, Philadelphia, Pa.

SPECIAL PRICES

DIRECT CURRENT MOTORS

14—150-H.P., 230-Volt, 1050 R.P.M. Interpole shunt wound Sprague 6-pole complete with starting panels. Will compound fields if required.

Large stock 25 and 60-cycle slip ring G. E. motors

Ask for Our Motor Bulletin

THE W.G.NAGEL ELECTRIC CO.
28-30-32 ST.CLAIR ST.
TOLEDO, OHIO.

DIRECT CONNECTED GENERATOR SETS

1—50 Kw., 250 v., 300 rev. Westinghouse D.C. to Buckeye steam engine, completely overhauled
1—75 Kw., 250 v., 300 rev. Westinghouse D.C. to 125 H.P. Westinghouse steam engine with swbd.
1—100 Kw., 250 v., Ft. Wayne D.C. to 16 x 18, 4-valve Russell steam engine with swbd.
1—400 Kw., 250 v., Westinghouse D.C. to 24 x 28 Wether'll heavy duty steam engine with swbd.

BELTED GENERATORS

1—75 Kw., 250 v., 1100 rev. cpd. wd. Bullock complete.
2—150 Kw., 250 v., 600 rev. cpd. wd. Cr. Wheeler complete.

MINING MACHINE

1—Jeffrey Short Wall, 250 v., 42-in. gauge, 6-ft. cutter bar with new extra armature, cutting chain and cable.

ANY SIZE BOILERS, A.C. AND D.C. MOTORS SHIPPED FROM STOCK. Send for our monthly stock sheet.

PARSONS-MOORHEAD MACHINERY CO.
Pittsburgh Life Bldg., 6th and Liberty Ave., Pittsburgh, Pa.

MOTORS AND GENERATORS

ALL FOR IMMEDIATE DELIVERY

2—50-kw., 125-v. Western Electric D.C. Generators, direct connected to Ball Engines.
1—75-hp., 220-v., 900 r.p.m. General Electric, type ITC, slip ring, 3-ph., 60-cy. motor.
2—150-hp., 440-v., 600 r.p.m. General Electric, type MT, 3-ph., 60-cy., new slip ring motors.
1—150-kw., 500-v., direct current Generator.
1—150-kw., 2300-v. Fort Wayne, type TRB, 3-ph., 60-cy. Alternator.
1—175-kva., 480-v. Allis-Chalmers, 3-ph., 60-cy. Alternator complete. USED THREE MONTHS.
100—1/4-hp., 110/220-v. General Electric, type RSA, new single-phase, 60-cy. repulsion type Motors.

Large Stock A.C. and D.C. New and Used Motors on Hand.
Write for Monthly Stock Bulletin.

CHICAGO ELECTRIC COMPANY
(Formerly Chicago Elect. Const. Co.)
740 W. VAN BUREN STREET, CHICAGO
Long Distance Phone: Haymarket 8166.

NEW AND SLIGHTLY USED

Mechanical Equipment

FOR SALE—IMMEDIATE DELIVERY

POTS	MOTORS	FILTER PRESSES
FANS	ENGINES	ALCOHOL UNITS
STILLS	NITRATORS	GENERATOR SETS
KILNS	ACID PLANTS	TIN CONTAINERS
TANKS	AUTOCLAVES	DISTILLING UNITS
PUMPS	EVAPORATORS	RECTIFYING UNITS
CRANES	CENTRIFUGALS	AIR COMPRESSORS
KETTLES	SULPHONATORS	HYDRAULIC PRESSES
DRYERS	VACUUM PANS	GLASS LINED TANKS
MIXERS		

→ SEND FOR *TECHNICAL PRODUCTS ECONOMIST*, LISTING 1000 ITEMS ←

BOILERS

CG-173-A—8—161 hp. Bigelow hor. ret. tub. Boilers, 150 lb., triple riveted, double butt strapped.
TP-1651-I—2—200-hp. water tube Boilers, Detroit stokers, 125 lb.
CG-284-A—2—302-hp. B. & W. Boilers, for 160-lb., 3,021 sq.ft. heating surface each, in two batteries, 16 sections of 9, 4-in. x 18-ft. tubes. Perfection grates, 68 sq.ft. Full front. Murphy stokers, feed pumps and heater. Space per two boilers, 24-ft. 2-in. x 20-ft. 2-in. deep, 16-ft. 8½-in. floor to steam outlet flange. Hartford inspected. Pa.
TP-1663-A—1—350-hp. Erie City vertical water tube Boiler, 125-lb. pressure.
CG-175-B. 450-hp. Hawkes Boiler, 150 lb., Lyon type, complete with steel castings, arranged for Dutch Oven. Hartford inspected.
CG-410-A—4—600-hp. Babcock & Wilcox boilers. New, never set up, 200 lb. steam pressure. Built according to A. S. M. E. Boiler Code. Each boiler has 6,001 sq.ft. heating surface. Dietrich arches. Detroit stokers. Md.

SMOKE STACKS

TP-1662-Q. Smoke stack, 30-in. diam. 64 ft. high, 3/16-in. steel, with breeching.
TP-1652-E. Stack, 40-in. diam., 70 ft. high, ¼-in. steel, with breeching, guys and damper.
CG-184-L.—2—30-in. x 50 ft. steel smoke stacks, ¼-in. plate.
TP-1678-A—3 guyed steel Stacks, 60-in. diam., 98 ft. high, ¼-in. plate. N. J.

GENERATORS, D.C.

CG-376-A—Two 100 K.W. 120 volt General Electric Multipole Generators, direct connected to a Harrisburg Engine, 250 r.p.m.
CG-54-K—300 K.W., 125 volt, D.C. Kerr Allis Chalmers turbo Generator Set. Operating condensing. 0.
C - 15—400 hp. 21 x 22 in. Skinner Unaflow Engine, operating at 150 lb. pressure, 200 r.p.m., direct connected to a 150 K.W. 500 volt, DC, Crocker-Wheeler Generator on one side, and to a 75 KW, 125 volt, DC, Crocker-Wheeler Generator on opposite side.
CG-289—1,200 KW. Crocker-Wheeler compound wound Generator, 250 volt, direct connected to a 28 and 56 x 48 in. stroke Watts-Campbell Corliss cross compound Engine. Complete with Blake & Knowles jet condenser and pumping equipment.

GENERATOR, A.C.

GC-329-C—250 K.W. belted Generator made by Electric Machinery Co. 220 volt, 60 cycle, 3 phase, 720 r.p.m., with belted exciter.

TURBO GENERATOR SETS—A.C.

CG-299—15 K. W., 3 phase, 60 cycle, 11,000 volt General Electric Generator, direct connected to multi-stage Curtis Turbine. Operating condensing, non-condensing equipment included.
CG-311-E—150 KVA (120 K.W.) Westinghouse Generator, 3 phase, 60 cycle, 2,300 volt, 600 r.p.m., direct connected to a 220 hp. horizontal double runner closed type Leffel Water Turbine. Operating under a 45 ft. head with 40 in. intake and 17 in. runners. Complete with exciter, switchboard and instruments.
CG-331-A—500 K.W., 3 phase, 60 cycle, 2,300 volt, General Electric Generator direct connected to Curtis vertical single stage turbine now operating non-condensing. By addition of runner in the last stage and the supplying of necessary condenser equipment, turbine can be changed to operate condensing.
CG-400—Two 500 K.W., 3 phase, 25 cycle, 6,600 volt Westinghouse Generators, driven through common shaft by a Parsons multi-stage reaction type turbine. Operating condensing under 175 lb. pressure.
TP-860-E—700 K.W., 3 phase, 60 cycle Generator, 4,150/2,400 Y between phase and neutral, direct connected to horizontal water wheel, 200 r.p.m. Many other sizes available.

LOCOMOTIVES (Electric)

TP-1640-J—2—Electric Locomotives, 36-in. gage, capacity 8 to 10 ton, weight 3,600 lb. each, 4-ft. wide, 5 ft. long, with necessary battery.
TP-1640-K—3—Industrial Tractors, capacity 5 to 7 ton, 36-in. gage, weight 2,400 lb., with 30 A4 Edison cells each, width 37 in., length 48 in. over all.
ON-1745-A—2—5-ton Storage Battery Locomotives, 36-in. gage, with 40 cells MV 13 iron clad oxide storage battery, capacity 189 amps., 80 volts, draw bar pull 800 lb., 5.2 miles per hour.

OIL ENGINES

TP-268-E—2—225-hp. American Busch-Sulzer Diesel Oil Engines, 3-cyl. ver. 16 x 24-in., 165-r.p.m., with Dodge, 250-hp. friction clutch pulley, 45 x 26-in. face, fly-wheel, 8 ft. x 16 in. face. Burn 13 gal. oil per hour. In good operative condition. N. Y.
CG-274—1—New 500-bhp. Diesel oil Engine, Southwalk Fdry. & Mach. Co. make, 4 cyls., 16 x 28-in., 150-r.p.m., quick starting. Auxiliary equipment included. Pa.

TECHNICAL PRODUCTS COMPANY, Inc.
501 Fifth Avenue, New York
Chicago ✻ Toronto

Fairbanks-Morse Motors

NEW

440-Volt 3-Phase, 60-Cycle

5—7½-hp., 1800 r.p.m., squirrel cage
5— 10-hp., 1800 r.p.m., squirrel cage
21— 15-hp., 1800 r.p.m., squirrel cage
4— 25-hp., 1800 r.p.m., squirrel cage
3— 35-hp., 1800 r.p.m., squirrel cage
3— 50-hp., 900-r.p.m., squirrel cage
2—250-hp., 600 r.p.m., slip ring

THE ELLIOTT ELECTRIC CO., CLEVELAND

MOTORS

In Stock—Immediate Shipment

VARIOUS SIZES AND SPEEDS

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DAVIS MACHINE & MOTOR CO.
59 Mechanic Street, Newark, N. J.
Phone Market 8580

FOR SALE—IMMEDIATE DELIVERY

TRANSFORMERS

3—30 kva., 1100/2200, 110/220 volts, G. E. type H, form K, 60 cycles, serial No. 1,471,724—1,472,945—1,473,322.
1—G. E. type R.B., form A, CC transformer 2200/4400-volt primary, 6.6 amp. secondary, 60-cycle, 8-kw. capacity, serial No. 525648.
4—2250 kva., S. P., 3 coil G.E. outdoor W.C. transformers, 66000/13200-2300 volt, No. 1,065,501-2-3-4.

REGULATORS

3—75 amp., 2200 volts, S. P. feeder regulator, G. E. type BR, form A-3, 16.5 kw. capacity, 10% reg., serial No. 973,671.

Greenfield Electric Light & Power Co.
Greenfield, Mass.

IMMEDIATE DELIVERY

20-Hp. General Elec., 3 Phase, 220 Volts, 900 R.P.M.
50-Hp. Wagner, 3-Phase, 20 Volts, 900 R.P.M.
30-Kw., 220 Volts D.C. Generator.
55-Hp., 220 Volts D.C., 520 R.P.M.

MOTOR EXCHANGE, 327 N. 3rd St., Phila., Pa.

BARGAIN

For Sale—Immediate Delivery—Used Alternator—52½-kva. Crocker-Wheeler, single phase, 60-cycle, 240-volt, 900-r.p.m., with pulley and field rheostat; in excellent shape. Price $500.00, without exciter.

Spaulding Electric Co., Detroit, Mich.

Brown-Hunkele Corporation

Power Engineers

Electric Motors and Power Equipment

12-24-26 Mechanic Street, Newark, N. J.

SPECIAL EQUIPMENT

We have taken over the entire machinery of one of the largest smelting and refining plants in the East and can offer for immediate delivery, subject to previous sale, the following equipment, that has been used but a short time for the Electrolytic process of reclaiming copper.

Equipment has been purchased by us at such a reduction in price that we can make wonderfully attractive prices on it.

1—330 kw., 60 v., 5500 amp. Crocker-Wheeler, D.C. generator, direct connected to a Tandem Compound Corliss Engine, 16 x 50 x 42, with Deane Jet Condenser and Vacuum Pump, Switchboard and all appurtenances necessary for the complete operation of the unit.

1—344 kw., 80 v., 4300 amp., Type CH., Crocker-Wheeler D.C. Generator, direct connected to a Cross Compound Corliss Engine, size 16 x 30 x 42, with Worthington Jet Condenser, Vacuum Pump, Switchboard and all appurtenances necessary for the complete operation of the unit.

1—150 kw., 250 v., 600 amp., compound wound, Crocker-Wheeler Generator, direct connected to an Ideal Tandem Compound Engine, size 13 x 22 x 18 in. stroke with a Deane Jet Condenser, Vacuum Pump, Switchboard and all appurtenances necessary for the complete operation of the unit.

1—150 kw., 600 amp., 250 v., Type CCD., Crocker-Wheeler, D.C. Generator, compound wound, direct connected to an 18 x 18 Straight Line Engine, with Switchboard, complete in full with all necessary appurtenances for the complete operation of the unit.

1—Hansen and Van Winkle, 5000 amp. Plating Generator, in excellent condition, complete with all necessary appurtenances and an excellent 10 x 24 Corliss Engine for belting to the Generator.

MOTORS

A.C., 60-CYCLE, 2 PHASE, 220-440 VOLTS

1—75-hp., 900 r.p.m., Allis-Chalmers Slip Ring Motor complete; new.
1—75 hp., 900 r.p.m., Fairbanks-Morse Type B Slip Ring Motor, complete; new.
2—50 hp., 900 r.p.m., Fairbanks-Morse Type B Motor complete; new.
2—50 hp., 900 r.p.m., Western Electric, 50 degree Motors complete; new.
1—50 hp., 1200 r.p.m., Allis-Chalmers Slip Ring Motor complete; new.
2—40 hp., 900 r.p.m., General Electric, 50 degree Motors complete; new.
2—30-hp., 1200 r.p.m., Fairbanks-Morse Type B Motors complete; new.
1—30-hp., 900 r.p.m., General Electric, 50 degree Motor complete; new.
2—25-hp., 1200 r.p.m., Fairbanks-Morse Type H Motors complete; new.
2—25-hp., 1200 r.p.m., General Electric, 50 Degree Motors complete; new.
2—25-hp., 900 r.p.m., General Electric, 50 Degree Motors complete; new.
1—25-hp., 1200 r.p.m., Allis-Chalmers Slip Ring Motor complete; new.
6—20-hp., 1200 r.p.m., Fairbanks-Morse Type B Motors complete; new.
1—20-hp., 900 r.p.m., General Electric Slip Ring Motor complete; used.
4—20-hp., 1200 r.p.m., General Electric 50 degree Motors complete; new.
4—20-hp., 900 r.p.m., General Electric 50 degree Motors complete; new.
2—15-hp., 1700 r.p.m., Westinghouse Type CCL Motors complete; used.
3—15-hp., 1200 r.p.m., Fairbanks-Morse Type B Motors complete; new.
4—15-hp., 1200 r.p.m., General Electric 50 degree Motors complete; new.
4—15-hp., 900 r.p.m., General Electric 50 degree Motors complete; new.
2—15-hp., 1200 r.p.m., Allis-Chalmers Slip Ring Motors complete; new.
6—10-hp., 1800 r.p.m., General Electric 50 degree Motors complete; new.
6—10-hp., 1200 r.p.m., General Electric 50 degree Motors complete; new.
2—10-hp., 1800 r.p.m., Allis Chalmers Motors complete; new.
2—10-hp., 1200 r.p.m., Allis-Chalmers Motors complete; new.
2—10-hp., 1800 r.p.m., Allis-Chalmers Slip Ring Motors complete; new.
2—10-hp., 1200 r.p.m., Allis-Chalmers Slip Ring Motors complete; new.
3—10-hp., 1800 r.p.m., Fairbanks-Morse Type B Motors complete; new.
5—10-hp., 1200 r.p.m., Fairbanks-Morse Type B Motors complete; new.
2—7½-hp., 1200 r.p.m., Westinghouse Type C Motors complete; new.
1—7½-hp., 860 r.p.m., Westinghouse Type C Motors complete; used.
1—7½-hp., 1150 r.p.m., Wagner Motor complete, used.
4—7½-hp., 1800 r.p.m., General Electric 50 degree Motors complete; new.
6—7½-hp., 1200 r.p.m., General Electric 50 degree Motors complete; new.
1—7½-hp., 1200 r.p.m., Allis-Chalmers Slip Ring Motor complete; new.
3—7½-hp., 1800 r.p.m., Allis-Chalmers Motors complete; new.
1—7½-hp., 1800 r.p.m., Fairbanks-Morse Type B Motors complete; new.
4—7½ hp., 1800 r.p.m., Westinghouse Type CCL Motors complete; used.

A.C., 60-CYCLE, 3-PHASE 220-440 VOLTS

1—150-hp., 720 r.p.m., General Electric Squirrel Cage Motors; used.
2—75-hp., 900 r.p.m., Western Electric Motors complete; new.
2—50-hp., 1800 r.p.m., Allis-Chalmers Motors complete; used.
7—50-hp., 900-r.p.m., Fairbanks-Morse Type B Motors complete; used.
2—50-hp., 900 r.p.m., W. E. Motors complete; used.
2—40-hp., 1200 r.p.m., Wagner Motors complete; used.
6—30-hp., 680 r.p.m., Allis-Chalmers Motors complete; used.
3—30-hp., 1800 r.p.m., G. E. Motors complete; used.
1—25-hp., 900 r.p.m., Westinghouse Type C Motors complete; used.
3—20-hp., 1200 r.p.m., G. E. Motors complete; used.
5—20-hp., 900 r.p.m., G. E. Motors complete; used.
2—20-hp., 1800 r.p.m., G. E. Motors complete; used.
1—20-hp., 680 r.p.m., Allis-Chalmers Motors complete; used.
4—15-hp., 1200 r.p.m., G. E. 50 degree Motors complete; new.
3—10-hp., 1800 r.p.m., G. E. 50 degree Motors complete; new.
4—10-hp., 1200 r.p.m., G. E. 50 degree Motors complete; new.
2—10-hp., 1800 r.p.m., Allis-Chalmers Motors complete; new.
2—10-hp., 1200 r.p.m., Allis-Chalmers Motors complete; new.
2—10-hp., 1800 r.p.m., Fairbanks-Morse Type B Motors complete; new.
1—10-hp., 1800 r.p.m., G. E. Motor complete; used.
4—7½-hp., 1800 G. E. 50 degree Motors complete; new.
4—7½-hp., 1200 r.p.m., G. E. 50 degree Motors complete; new.
2—7½-hp., 1200 r.p.m., Allis-Chalmers Motors complete; new.
1—7½-hp., 1800 r.p.m., G. E. Motor complete; used.
5—5-hp., 1800 r.p.m., G. E. Motor complete; used.
6—5-hp., 1800 r.p.m., G. E. Motor complete; new.
6—5-hp., 1200 r.p.m., G. E. Motor complete; new.
6—3-hp., 1800 r.p.m., G. E. 50 degree Motors complete; new.
6—3-hp., 1200 r.p.m., G. E. 50 degree Motors complete; new.
11—2-hp., 1800 r.p.m., Crocker-Wheeler 50 degree Motors complete; new.
6—2-hp., 1800 r.p.m., G. E. 50 degree Motors complete; new.
6—2-hp., 1200 r.p.m., G. E. 50 degree Motors complete; new.
1—2-hp., 1200 r.p.m., Jenny Slip Ring Motors complete; used.

NEW MOTORS—Immediate Shipment

Quan.	Hp.	Volts	Rpm.	Type	Make
1	40	220	1200	B	Fairbanks-Morse
1	40	220	1200	H	Fairbanks-Morse
1	40	440	900	H	Fairbanks-Morse
1	50	440	900	H	Fairbanks-Morse
1	50	220	1200	H	Fairbanks-Morse
1	50	440	850	AN	Allis-Chalmers
1	75	440	900	B	Fairbanks-Morse
1	75	220	865	AN	Allis-Chalmers
1	100	220	865	AN	Allis-Chalmers
1	150	2200	600	Q	Crocker-Wheeler

PRICE $1400.00

GEO. F. MOTTER'S SONS
Steam and Electrical Engineers
YORK, PA.

MOTORS—DYNAMOS

105-hp. General Electric, 500-volt, D.C. motor.
2-hp. Century, 104/208-volt, 1-phase, 125-cycle.
½-hp. Wagner, 110-volt, 1-phase, 133-cycle.
2—22½-hp. KW Akron Generators, 110-volt, D.C.
45-hp. Western Electric, 110-volt, D.C. motor.
45-hp. Westinghouse, 220-volt, D.C. motor.
25-kw. Crocker-Wheeler Generator, 220-volt, 3-phase.
Immediate Delivery.

A. WERBY & CO.
47 Beverly St., Boston, Mass.

ELECTRICAL MACHINERY BARGAINS

4— 25-H.P., 1800-R.P.M., 220/440 volt, 60-cycle, 3-phase motors
2— 40-H.P., 900-R.P.M., 220/440-volt, 60-cycle, 3-phase motors
5— 50-H.P., 900-R.P.M., 220/440 volt, 60-cycle, 3-phase motors
1—100-H.P., 900-R.P.M., 220/440-volt, 60-cycle, 3-phase motors
1—100-H.P., 1200-R.P.M., 220-440-volt, 60-cycle, 3-phase motor
1—621-Kw. 900-R.P.M., 2300-volt, 60-cycle, 3-phase generator
1—175-Kw., 600-R.P.M., 2300-volt, 60-cycle, 2-phase generator
1—100-Kw., 360-R.P.M., 125-volt direct current generator.
1— 30-Kw., 300-R.P.M., 115-volt, D.C., engine generator set

V. M. NUSSBAUM & COMPANY, Fort Wayne, Indiana

550 VOLTS, 3 PHASE, 60 CYCLE

4—WESTINGHOUSE MOTORS, 600 R.P.M.

PRACTICALLY NEW, IMMEDIATE DELIVERY,
COMPLETE STOCK A.C. AND D.C. MOTORS.

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CRANE—FOUNDRY LADLE

1—20-ton, all-steel, 2-motor trolley, 6-ft. spread, with 25-hp. hoist motor and 5-hp. rack motor, 230-volts D.C.
1—10-ton Tilting Ladle, 58-in. diameter, 50-in. deep; thickness of shell ⅝-in.; hand operated spur gear tilting device, 30-in. hand wheel.

THE ELECTRIC SERVICE CO.
212 Walnut St., Cincinnati, Ohio

THE SEARCHLIGHT SECTION

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Are you using the Searchlight?

FOR SALE

1—250 KVA Bullock A. C. 480/2300 volts, 60 cycle, 3 ph. dir. con. to 18¾-in. x 21-in. Buckeye L. H. Automatic H. D. Engine.

1—250 KVA Crocker-Wheeler A. C. 480/2300 volts, 60 cycle, 3-ph. dir. con. to 15-in. and 27-in. x 21-in., Erie City, L. H. 4-valve engine.

1—150 KW, Western Electric Belted Type A. C. Generator, 3-ph., 60 cycle, 240/480 or 2300 volt.

WANTED

1—25 to 30 KW., 250 volt D. C. dir. con. set.
1—150 K.W., 125 volt, D. C. dir. con. to 4-valve engine.

R. L. BAKER, 30 N. La Salle St., Chicago

Brand New Generating Units

For Shorter Delivery

2—312 Kva., 60-cycle, 3-phase, 2,300 volts, General Electric alternators, directly connected to simple non-releasing Corliss engine, including belted exciters.

1—312 Kva., 60-cycle, 3-phase, 480 volts, Western Electric alternator with simple non-releasing Corliss engine, including belted exciter.

1—480 Kva., 60-cycle, 3-phase, 450 volts, Western Electric alternator, directly connected to simple non-releasing Corliss engine, including belted exciter.

1—450 Kva., 60-cycle, 3-phase, 2,300 volts, General Electric alternator with simple non-releasing Corliss engine, including belted exciter.

1—675 Kva., 60-cycle, 3-phase, 2,300 volts, General Electric alternator, directly connected to simple non-releasing Corliss engine, including belted exciter.

1—75 Kw., 125-250 volts, 3-wire Western Electric, direct current generator, directly connected to simple non-releasing Corliss engine, including standard switchboard for immediate shipment.

2—200 Kw., 250-275 volts, Western Electric, direct current generator, directly connected to simple non-releasing Corliss engines, including standard switchboard.

1—300 Kw., 250-275 volts, General Electric, direct current generator, directly connected to simple non-releasing Corliss engine, including standard switchboard.

CHUSE ENGINE & MANUFACTURING COMPANY
Mattoon, Illinois

FOR SALE

300 H. P. G. E. INDUCTION MOTOR

Serial No. 69381—3 bearing Type I, Class 14-300-514, Form L, Cycles 60, H.P. 300, Volts 550, Amp. 245. Without slide rails, Compensator or Pulley. Price $2750. Ex. San Francisco Warehouse.

Shattuck Construction Co.
517 Underwood Bldg., San Francisco

FOR SALE

BOILERS

2—H.R.T. boilers with full flush fronts and all trimmings, nearly new, size 66 in. x 18 ft. One boiler triple riveted butt joint with two cover straps. One boiler quadruple riveted with two cover straps.

Boilers have been removed from setting and cleaned and painted.

Price $1,000 each F.O.B. Orion, Ill.

SHERRARD POWER SYSTEM
Orion, Ill.

MOTOR FOR SALE

1—Westinghouse synchronous motor, 150-hp., 2-phase, 2200-volts, complete with exciter and switch panel.

Immediate delivery

BELL & CO., Savannah, Ga.

150 KVA. BELTED

Western Electric Generator, now 2-ph., 60-cycles, 440-volts, 600 rpm. can be changed to 3-ph., 220 or 440-volts. Practically brand new—used about two months—must be moved.

POWER EQUIPMENT COMPANY
Engineers
1809 Buttonwood St., Philadelphia, Pa.

FOR SALE

ATTRACTIVELY PRICED FOR QUICK SALE

1—9000-Kw., 6600 or 11500-Volt, 3-Phase, 60-Cycle

GENERATOR

directly connected to G. E. Turbine

This unit is of a vertical type mounted on a surface condenser having all auxiliary equipment complete, including duplicate high pressure and low pressure oil pumps, filtering apparatus, etc., and one spare step bearing, available for immediate service. Inspectable at Charleston, W. Va.

THE VIRGINIAN POWER COMPANY
CHARLESTON, W. VA.

FOR SALE

STEAM ENGINES

We are changing power from steam to electric drive and the following engines will be released from service in July and are offered for sale for F.O.B. delivery in July or August:

One pair E. P. Allis & Co.'s Reynolds-Corliss engines, 26 in. x 60 in. cylinders, 24 ft. x 60 in. double-crown flywheel, 500 hp. each or 1000 hp. as now coupled.

One E. P. Allis & Co.'s Reynolds-Corliss engine, 26 in. x 60 in., with 24 ft. x 44 in. flywheel, about 500 hp.

One E. P. Allis & Co.'s Reynolds-Corliss engine, 28 in. x 48 in., with split flywheel, 20 ft. x 60 in., capable of being run with either one or two belts, now running with two belts.

Can be seen in operation any day in each week up to Saturday noon and idle that afternoon and Sunday.

HENDERSON COTTON MILLS, Inc.
HENRSYKON, DE.

MOTORS

2—New Type HV Fairbanks-Morse, 250 H.P., 600 r.p.m., 3-phase, 60-cycle, 440-volts, 40 degree continuous service slip ring motors. Immediate shipment from Indianapolis, Indiana.

FAIRBANKS, MORSE & CO.
30 Church St., New York City

FOR SALE

3—333 kva. Transformers, General Electric, Type H, Primary, 11,000 volts, secondary 240-480 volts, 60 cycles; oiled cooled with oil.

Complete fittings of outdoor substation consisting of disconnect switch, reactance insulators, primary and secondary bus-bars, four lighting arresters, connections, four poles and brackets, etc.

Price F.O.B. Norfolk, Virginia, for the lot, Forty Eight Hundred Dollars $4800.00

Subject to prior sale.

FRED. W. WALTER
215-17 Cumberland St., Norfolk, Virginia

IMMEDIATE DELIVERY

GOOD AS NEW

4—480 HP.
(2 of the 4 have been sold)

STERLING WATER TUBE BOILERS

Code built, 160 lb. working pressure, hand-fired grates, complete with all fittings.

Quick Action Necessary
Wire or write for inspection

John A. Stewart Electric Co.
408 First National Bank Building,
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50-Kw., 125-V., Westinghouse, Gen. Hor. Auto Eng., 275 rev., sw. bd. Price, Cars, $1,000—Indianapolis. 500-Kw. C.C. Corliss., 250-V.

ROSS POWER EQUIP. CO.
Indianapolis, Ind.

H.P.	BOILERS	H.P.
3-1000 Heine	200 lb. (new)	27-250 B &W 150 lb.
1-550 Alt. T.	160 lb.	10-250 Wickes 150 lb.
1-617 Stirl.	150 lb.	2-150 Heine 150 lb.
1-400 Stirl.	150 lb.	2-84x18 HRT 100 lb.
1-275 Stirl.	150 lb.	4-72x18 HRT 175 lb.
2-250 Stirl.	160 lb.	6-72x18 HRT 125 lb.
2-250 Heine	200 lb. (new)	260x16 HRT 150 lb.

Crockwell Mine & Mill Supply Co
417 Pine Street, St. Louis

BRAND NEW ¼-HP. SINGLE-PHASE MOTORS

110-volt, 60-cycle, constant duty, 1750 r.p.m.; immediate delivery. Money back guarantee. Price $24.50.

Also 100 1/30-hp. Induction Motors, double shaft extension, 1150 r.p.m., above ratings. Price $18.50 each. We buy motors 25% with order balance C.O.D.

General Distributing Co., Duluth, Minn.

Special Synchronous Motor

225 H.P., 3-ph., 60-cyc., 600 r.p.m., 220 or 440 volt, Westinghouse, serial No. 1,047,916, complete with starting apparatus and exciter. Price $3,300. Immediate delivery.

The Electric Motor and Repair Co.
Akron, Ohio.

SOME ONE WANTS TO BUY

the equipment or machinery that you are not using. This may be occupying valuable space, collecting dust, rust and hard knocks in your shops and yards.

SELL IT BEFORE DEPRECIATION SCRAPS IT

THE SEARCHLIGHT SECTION IS HELPING OTHERS
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75 K.W.

75 K.W., 220-250 volts, 275 R.P.M., direct current Sprague Generator, D.C. to 14 x 12 Harrisburg heavy duty, side crank automatic engine; A-1 condition.

Can be seen running.

Coleman-Shoemaker, Inc.
Commercial Trust Building
Spruce 978
Philadelphia, Pa.

Guaranteed Motor Company

628 West Lake St., Chicago, Ill.

New and Used Motors

BOUGHT, SOLD AND RENTED

Following Motors in Chicago Stock

ALTERNATING CURRENT, 3-Phase, 60-Cycle
Connected for either 220 or 440-Volts

Qu.	Hp.	Speed	Make	Condition
3	15	1800	Fairbanks-Morse	New
2	15	1200	Fairbanks-Morse	New
3	25	1800	Fairbanks-Morse	New
2	30	900	Crocker-Wheeler	New
2	35	1800	Fairbanks-Morse	New
1	35	1200	Westinghouse	Rebuilt
2	35	900	Westinghouse	Rebuilt
2	40	900	Western Electric	Rebuilt
1	50	900	General Electric	Rebuilt
2	50	720	Crocker-Wheeler	Rebuilt
1	50	720	Triumph	Rebuilt
1	100	900	Westinghouse, Sl. Rg.	.....

ALTERNATING CURRENT, 3-Phase, 25-Cycle
Connected for either 220 or 440-Volts

Qu.	Hp.	Speed	Make	Condition
1	15	1500	Allis-Chalmers	Rebuilt
1	15	750	Allis-Chalmers	Rebuilt
3	15	750	Westinghouse	Rebuilt
2	20	750	Wagner	Rebuilt
1	20	750	Westinghouse	Rebuilt
1	30	1500	Wagner	Rebuilt
2	40	750	General Electric	Rebuilt

SMALLER A.C. UNITS

A complete assortment of A.C. Motors in smaller sizes always available.

D.C. MOTORS

A large assortment of D.C. Motors ranging from 150-hp. down, ready for immediate shipment.

SINGLE PHASE MOTORS

We have a good assortment, both new and rebuilt.

All motors rebuilt in our own shops and guaranteed to be in as good condition in every way as when new.

IMMEDIATE DELIVERY

60-Cy., 3-Ph. Steam Turbines

2—500-Kw., 600-v., G. E. Ry. Turbo Sets.
187 and 125-Kva., 2300-v., G. E. Non-cond.
500-kw. 600 Condensing.
300-Kw. 125-v., D.C., Allis-Kerr Cond.
375-Kva., 240-v., 2-phase, Allis Cond. Type C.
937-Kva., 480-v., Westinghouse horizontal, LeBlanc cond.
1250-Kva. Allis, 6600-v., Cond.
1250-Kva. horizontal, G. E., 2300-v., Cond.
1875-LOW PRESSURE. 2300-v., Westinghouse Cond.
2000-Kva. 2300-v., Westinghouse Surf. Cond.
2500-Kva., 2300-v., Westinghouse and Surf Cond.
5000-Kva., 2300-4150-v. (Hor) turbo (Surf. Cond.)

ENGINE TYPE A-C, 60-CY., 3-PH. SETS, Etc.

2—125-Kva., 2300-v., Comp. Engine sets.
360-Kw. 2300-480-v., Tan. Comp., 150 rev.
750-Kva. 2300-v., G.E. Allis, 22 x 42 x 44.
1000-Kva., 2300-480-v., 24, 48 x 48 eng. 100 R.
3300-Kva., 2300-v., 3-phase, C-C engine sets.
937-Kva., 2300-480-v., G.E., C.C., Eng. Set 150 rev.
250-Kva., G.E., 2300-v., 200 r.p.m. Gen. only.
625-Kva., 220-v., 2-phase, C.C., 150 r.p.m.
625-Kva., 2300-v., G.E., C.C. engine.
360-Kw., 2300-v., G.E.T., com. 4-valve eng.
2—4500-Kw., 300 r.p.m., vert., 25-cy. wtr. wheel.
3—150 hp., H.R.T. Boilers, 130 lb., F. S. 5.
1—200-hp., 220-v., 500 r.p.m., D.C. motor.
7—Railway Rotaries, 300-750-kw., 25-60-cy.
5—420-hp., B. & W., 180 lbs. stokers, Sup. Htr.
6—500-hp., Sterling, 150. Roney Stokers.
2—500-Kw., 60-cy. Ry. M.G. sets.
3—1000-Kva., 370-v., 25-cy., C.C. Corliss.

BELTED A-C, 60-CY., 3-PH. GENERATORS

50 Engines, 50-hp. to 1800 hp.
125-Kva., 240-v., 900 r.p.m., G.E., D.C. Ex.
187-Kva., 240-480-v., 600 r.p.m., Westinghouse.
250-Kva., 2300-v., G.E., 200 r.p.m. Gen. only.
300-Kva., 2300-v., 600 rev G.E.
312-Kva., 240-v., 600 rev.
Rotaries, Rock Crushing Plants, Pumps, Condensors, Gas and Oil Engines.

ROSS POWER EQUIP. CO.

Indianapolis, Ind. Main 7200 L. D.

FOR SALE

2—Westinghouse Single Phase Transformers, outdoor type, 100 KVA, 22,000/440 volts, 25 cycles.
These transformers have been operated successfully at 60 cycles.
2—Westinghouse outdoor Transformers.
2—125 kva., single phase, 60 cycle, 22000 primary volts, 220-240 secondary volts.
2—75 KVA, 2300-volt, 60-cycle, 3-phase Burke Alternator with direct connected exciter, 900 RPM, with Rails and Pulley.
1—Ridgway Dynamo & Engine Company, 2300-volt, 150 KVA, 2-phase, 60-cycle, 720 RPM Alternator, complete with belted exciter, Rheostat, Rails and Pulley.
1—5 HP. Allis-Chalmers Induction Motor, 2-phase, 60-cycle, 110-volt, 1700 RPM, with Rails but no pulley.
1—1 HP. Westinghouse CCL Motor, 2-phase, 60-cycle, 1700 RPM.
1—75 HP. Westinghouse Gas Engine, two cylinders upright, in first class condition.

Johnsonburg Light & Power Co.
Johnsonburg, Pa.

NEW 550-VOLT.

A. C. MOTORS

PRICED LESS THAN NEW

1—30-Hp. Allis-Chalmers, 865 r.p.m. Complete.
2—25-Hp. General Electric, 1,200 r.p.m. Complete.
1—40-Hp. General Electric, 900 r.p.m. Complete.
2—20-Hp. General Electric, 900 r.p.m. Complete.

All 3-phase, 60-cycle
With Compensators and Pulleys
These Motors have never been uncrated
Ready to ship

ZELNICKER IN ST. LOUIS

Many Other Bargains

FOR SALE

GENERATOR ENGINE SET

75 KW. 110 volt D. C. generator with 275 R.P.M. horizontal engine.

MOTOR-GENERATOR SETS

80 KW. 220 volt D. C. generator with 3-phase 25-cycle motor.
85 KW. 110 volt D. C. generator with 3-phase 60-cycle motor.
100 KW. 220 volt D. C. generator with 3-phase 60-cycle motor.

Also large stock of new and rebuilt motors. Send us your inquiries.

SORGEL ELECTRIC CO.
Milwaukee, Wis.

For Sale—Prompt Delivery

Diesel Oil Engines, Gas Engines, Generators

AMERICAN DIESEL ENGINES

1—170 BHP., vert., 3-cyl., belted.
1—170 BHP., vert., 3-cyl., coupled to
1—150 Kva., 3-phase generator.
2—225 BHP., vert., 3-cyl., belted.
2—225 BHP., vert., 3-cyl., coupled to
2—150 Kw., d.c. generators.
1—225 BHP., vert., 3-cyl., coupled to
1—200 Kva., 3-phase, 60-cy., 2300-v. generator.
2—450 BHP., 6-cyl., each coupled to
3-phase, 60-cy., A.C. generator.
1—100 BHP. F.M., vert., 2-cyl., oil belted to
1—85 Kva., 3-phase, 60-cy., 2300-v., 900 r.p.m. generator.
1—75-80 BHP., horiz., 2-cyl., oil belted.
1—35 BHP., horiz., 2-cyl., oil; new.
2—25 BHP. F.M., type "Y," oil; new.
1—20 BHP. F.M., type "Y," oil engine.
1—150 BHP., 3-cyl., vert. gas engine, d.c. to
1—100 Kw., 220-v., D.C. generator.
1—100 BHP., vert., 3-cyl. gas engine, d.c. to
1—65 Kw., 125/250-v., 3-wire generator.
1—100 BHP., vert. gas engine, d.c. to
1—65 Kw., 125-v., D.C. generator.

All guaranteed in good operating condition before shipment.

A. McMILLAN
Specialist in Diesel Type Oil Engineering
628 Monadnock Block, Chicago, Ill.

For Immediate Delivery

Attractively Priced for Quick Sale

1—"HUNT" No. 2818 COAL CONVEYOR COMPLETE; Consisting of:
615 lineal ft. Conveyor Chain, with sheet steel buckets.
1 Pawl type belt driven driver.
245 lineal ft. Conveyor Track, on double rail stands.
305 lineal ft. Conveyor Track, on stands.
16 Dumpers.

And

All necessary accessories for a complete coal conveying outfit. Capacity approx. 50 tons per hour. Installed 1917; used but little and in excellent condition.

ALSO

1—FULL REVOLVING CRANE; Consisting of:
60 ft. latticed steel boom (brand new). Propelling engine, assembled and ready for operation.
Wire Rope and all necessary appurtenances. Runs on 14 ft. 6 in. gauge track. Capacity 6,000 lb.

Thoroughly overhauled and in first-class operating condition.

For further particulars apply

Narragansett Electric Lighting Company
Providence, R. I.

FOR SALE

1—16 x 30 Vilter single eccentric

CORLISS ENGINE

complete with force feed cylinder lubrication, Richardson-Phenix gravity lubrication and filtering system. Inertia governor.

Also

One Allis-Chalmers 86-kva., No. 1026777 three-phase, 60-cycle, 900-r.p.m.

ALTERNATOR

direct connected to exciter.

FS139—Electrical World
10th Ave. at 36th St., New York City

GAS ENGINE UNIT

Nash, 2-cylinder Gasoline Engine, vertical, direct Connected to a 12½-kw. C. & C., type S, 275 r.p.m., compound wound, 125-volt generator.

Will sell at bargain price. Write

NATHAN KLEIN & CO.
Howard and Center Sts., New York

FOR SALE

27—Electric Units from 300 to 10,000 kw.
16—Hoists, Electric Cars and Locomotives.
20—Water Tube Boilers.

Get Our Lists and Prices

J. F. DONAHOO COMPANY
Birmingham, Ala.

Power Machinery—Available Prompt Shipment—Ready for Service

Alternating Current Turbines

2—1,000 kw., 3-phase, 60-cycle, 2,300-v., 3,600 r.p.m., horizontal G. E., Lynn type.
1—1,000-kw., 3-phase, 60-cycle, 440-2,300-v., 3,600 r.p.m, horizontal Westinghouse, mixed pressure.
1—100-kw., 3-phase, 25-cycle, 440-v., 1,500 r.p.m. Burke Kerr.

Alternating Current Reciprocating Units

1—70-kw., 3-phase, 60-cycle, 2,300-v. G. E., direct connected, 12 x 14 Ball engine.
1—125-kw., 3-phase, 60-cycle, 2,300-v., 257 r.p.m. G. E., direct connected, 15 x 14 A. L. Ide & Sons engine.
1—175-kw., 3-phase, 60-cycle, 2200-v., 169 r.p.m. Westinghouse, direct connected, 14 x 32 Buckeye engine.
1—200-KVA., 3-phase, 60-cycle, 2,300-v., 225 r.p.m. Westinghouse, direct connected, 14 x 25 x 18 heavy duty tandem compound Harrisburg engine.
1—200-kw., 3-phase, 60-cycle, 440-v., 200 r.p.m. Westinghouse, direct connected, 14 x 24 Hamilton engine.
1—450-kw. 3-phase, 60-cycle, 2,300-v., 100 r.p.m. G. E., direct connected, 22 x 42 x 48 Allis cross compound engine.
1—800-kw., 3-phase, 60-cycle, 2,300-v., 100 r.p.m. G. E., direct connected, 24 x 48 x 48 McIntosh-Seymour heavy duty engine.

Alternating Current Gas Engine Unit

1—60-KVA., 3-phase, 60-cycle, 240-v., 300 r.p.m. G. E., direct coupled, 70-hp. Bruce MacBeth gas engine.

Belted Direct Current Generators

1—2-kw., 125-v., 1,700 r.p.m. Westinghouse.
1—3¾-kw., 125-v., 1,600 r.p.m. Westinghouse.
1—14-kw., 125-v., 1,425 r.p.m. G. E.
1—14-kw., 125-v., 750 r.p.m. G. E.
1—15-kw., 125-v., 1,050 r.p.m. Westinghouse.
1—37½-kw., 120-v., 1,050 r.p.m. Allis.
1—37½-kw., 120-v., 1,000 r.p.m. Allis.
1—40-kw., 250-v., 925 r.p.m. Ft. Wayne.
1—50-kw., 125-v., 275 r.p.m. Allis.
1—90-kw., 250-v., 775 r.p.m. Western.
1—100-kw., 250-v., 530 r.p.m. Westinghouse.
1—100-kw., 550-v., 600 r.p.m. G. E.
1—150-kw., 250-v., 550 r.p.m. Ft. Wayne.
1—300-kw., 550-v., 400 r.p.m. G. E.

Alternating Current Motors

53—¼-hp., 3-phase, 60-cycle, 220-v., 1,800 r.p.m. G. E.
1—5-hp., 3-phase, 60-cycle, 220-v., 1,800 r.p.m. Westinghouse.
1—7½-hp., 3-phase, 25-cycle, 220-v., 690 r.p.m., slip ring G. E.
1—15-hp., 3-phase, 60-cycle, 440-v., 870 r.p.m., slip ring Westinghouse.
1—15-hp., 3-phase, 60-cycle, 2,200-v., 1,200 r.p.m. Westinghouse.
1—20-hp., 3-phase, 25-cycle, 440-v., 750 r.p.m., slip ring Western.
1—20-hp., 1-phase, 133-cycle, 115-v., 1,550 r.p.m. Wagner.
1—22-hp., 3-phase, 60-cycle, 220-v., 900 r.p.m., slip ring G. E.
1—35-hp., 2-phase, 25-cycle, 220-v., 750 r.p.m. Burke.
1—40-hp., 3-phase, 60-cycle, 440-v., 900 r.p.m. G. E.
1—50-hp., 3-phase, 60-cycle, 220-v., 1,700 r.p.m. Westinghouse, direct connected, De Laval centrifugal pump.
1—75-hp., 3-phase, 60-cycle, 2,200-v., 900 r.p.m. G. E.
1—75-hp., 3-phase, 60-cycle, 220-v., 1,800 r.p.m. G. E.
1—75-hp., 3-phase, 60-cycle, 220-v., 900 r.p.m. G. E.
2—75-hp., 3-phase, 60-cycle, 440-v., 900 r.p.m., slip ring G. E.
2—100-hp., 3-phase, 40-cycle, 550-v., 400 r.p.m. G. E.
1—100-hp., 3-phase, 60-cycle, 2,200-v., 720 r.p.m. Allis.
1—100-hp., 3-phase, 60-cycle, 440-v., 900 r.p.m. Allis.
1—125-KVA., 3-phase, 60-cycle, 240-v., 900 r.p.m. Crocker syn.
1—150-hp., 3-phase, 25-cycle, 440-v., 720 r.p.m., slip ring Allis.
1—200-hp., 3-phase, 60-cycle, 440-v., 600 r.p.m. Allis.
1—250-hp., 3-phase, 60-cycle, 240-v., 900 r.p.m. Westinghouse syn.
2—300-hp., 3-phase, 25-cycle, 2,200-v., 487 r.p.m. Westinghouse.
1—400-hp., 3-phase, 60-cycle, 480-v., 900 r.p.m. Westinghouse syn.

Rotary Converters

1—300-kw., 3-phase, 60-cycle, 600-v., 600 r.p.m. Westinghouse, with two 150 KVA. transformers.
1—1,000-kw., 6-phase, 60-cycle, 250-v., 514 r.p.m. Westinghouse.

Direct Current Direct Connected Units

1—62½-kw., 125-v., 275 r.p.m. Westinghouse, direct connected, 12½ x 12 Westinghouse automatic engine.
1—100-kw., 300-v., 225 r.p.m. Western, direct connected, Russell engine.
1—150-kw., 125-v., 200 r.p.m. Westinghouse, direct connected, 14-in. x 25-in. x 18-in. Harrisburg tandem compound engine.
1—200-kw., 125-v., 200 r.p.m. Westinghouse, direct connected, 14½-in. x 28-in. x 19-in. tandem compound Harrisburg engine.
1—200-kw., 125-250-v., 3-wire, 200 r.p.m. Westinghouse, direct connected, 16 x 28 x 18 vertical Ball engine.
1—1,600-kw., 250-v., 100 r.p.m. G. E., direct connected, vertical cross compound McIntosh-Seymour engine.

Motor Generator Sets

1—10-kw., 125-v., 1,120 r.p.m. Westinghouse generator, direct coupled to 15-hp., 2-phase, 60-cycle, 440-v. Westinghouse motor.
1—35-kw., 125-v., 900 r.p.m. G. E. generator, direct connected 55-hp., 3-phase, 60-cycle, 2,300-v. G. E. motor.
1—50-kw., 125-v., 1,200 r.p.m. G. E. generator, direct connected 75-hp., 3-phase, 60-cycle, 440-v. G. E. motor.
1—50-kw., 250-v., 1,200 r.p.m. G. E. generator, direct connected 62½ KVA., 3-phase, 60-cycle, 440-v. synchronous motor.
1—125-kw., 550-v., 900 r.p.m. G. E. generator, direct connected 183-hp., 3-phase, 60-cycle, 2,300-v. synchronous motor.
1—150-kw., 250-v., 600 r.p.m. Ft. Wayne generator, direct coupled 200-hp., 3-phase, 60-cycle, 440-v. Allis motor.

Belted Alternating Current Generators

1—75-kw., 3-phase, 60-cycle, 2,300-v., 900 r.p.m. Western.
1—75-kw., 1-phase, 60-cycle, 2,200-v., 720 r.p.m. Westinghouse.
1—125-KVA., 3-phase, 60-cycle, 240-v., 900 r.p.m. Crocker.
1—125-KVA., 3-phase, 60-cycle 2,300-v., 900 r.p.m. G. E.
1—150-kw., 2-phase, 60-cycle, 2,300-v., 900 r.p.m. Bullock.
1—150-kw., 1-phase, 60-cycle, 2,200-v., 600 r.p.m. Westinghouse.
1—150-kw., 1-phase, 60-cycle, 1,100-v., 450 r.p.m. Ft. Wayne.
1—200-kw., 3-phase, 60-cycle, 240-v., 200 r.p.m. Ft. Wayne.
1—400-KVA., 3-phase, 60-cycle, 480-volt, 600 r.p.m. G. E.

THE NATIONAL POWER MACHINERY COMPANY

Electrical Department

Private Branch Exchange :
Main 2382.—Long Distance 224

1914-1918 Scranton Road
CLEVELAND, OHIO

A. C. UNITS

1000-kw. Westinghouse-Parsons Turbo, 3-60-4400 (a complete plant with boilers, etc.).
1000-kw. Westinghouse-Parsons Turbo, 3-60-2300.
235-kva. Westinghouse-Parsons Turbo, 3-60-440.
300-kw G. E., 3-40-240, 18 x 28 x 42 Fulton.
180-kva., 3-60-480 belted, 22 x 42 Allis.
75-kw. Westinghouse, 3-60-2300, 125-hp. tan. com. eng.
50-kw., 3-60-2300 belted, 12 x 36 Corliss.

D. C. UNITS

300-kw. Crocker-Wheeler, 550-volt, 20 x 27 Russell.
200-kw. Crocker-Wheeler, 550-volt, 19 x 20 Russell.
200-kw. Westinghouse, 275-volt, 22 x 18 E-Ball.
75-kw. Western, 125-volt, Atlas, 4-valve.
150-kw Ridgway, 275-volt, 19 x 18 McEwen.
100-kw. Bullock, 120-volt, 1. x 16 Skinner.
100-kw Ft. Wayne, 250-volt, 1 x 18 Russell, 4-v.
75-kw. Turbo Set, 125/250-volt, condensing.
Other sizes belted and direct connected.

CROCKWELL MINE & MILL SUPPLY CO.
208 N. Broadway, St. Louis

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500 H.P. DIESEL

Oil Engine, 164 Rev., suitable direct connection to generator; also rope sheave. An exceptionally fine unit.

475 KW. NEW G. E.

2300 volt, 60 cy., 3 ph., 1604 Rev. 400 & 500 KW., 250 V., C.C. Eng. Sets, Dir. Cur.

5000 K.V.A., 60-CY., 3-PH. TURBO

ROSS POWER EQUIP. CO.
Indianapolis, Ind.

25-Cycle Units

Immediate Delivery

SPECIAL BARGAIN

2—300 KW. Westinghouse, Engine Type Revolving Field Alternators, 25-Cycle, 3-Phase, 400 to 440 Volts. Direct Connected at speed of 107R.P.M. to Allis-Chalmers Cross Compound heavy duty Double Eccentric Modern type Corliss Engines. Condition practically new.

We offer the above for immediate shipment at a special sacrifice figure representing an unusual bargain.

PAUL STEWART AND COMPANY
Electrical and Steam Machinery
Cincinnati, Ohio.

Get your Wants into the Searchlight

IMMEDIATE SHIPMENT
16-in. Suction, 12-in. Discharge

WORTHINGTON CENTRIFUGAL PUMP

Driven through Herringbone Gear by 75 hp. Terry Steam Turbine; pump designed to deliver 4500 G.P.M. against 46-ft. Head, or 900 r.p.m. for Pump and 3600 r.p.m. for Turbine. Pump, Turbine and Gears mounted on one iron bed plate. First-class condition.

ARTHUR S. PARTRIDGE
415 Pine Street, St. Louis

FOR SALE

1—200 Kw. **Westinghouse Generator,** used two months, 600 r.p.m., 2200-v., 3-phase, 60-cycle, 35 deg. C. rating; excellent condition.

1—20 x 42 **Corliss Engine,** Filer-Stowel cylinder, 80 r.p.m., and Otis feed water heater; fair condition.

1—60-in. x 16-ft. **Return Tubular Boiler,** with 94 3½-in. boiler tubes, 125 lb.; manufactured at Menominee; excellent condition.

ESCANABA TRACTION CO.
Escanaba, Mich.

ELECTRIC EQUIPMENT

200-Kva., 220 volt Westinghouse 60 cycle Generator direct connected to an Erie City 4 valve Engine.

125-Kw. 125-250 volt Westinghouse 3 wire Generator direct connected to a 13 x 21 x 16-in. Ball Compound Engine.

100-Kw., 125 volt Fort Wayne Generator direct connected to a 16 x 14-in. Ames Engine.

50-Kw. 125 volt Fort Wayne Generator direct connected to a 13 x 12-in. Alfree Engine.

50-Kw., 250 volt C. & C. Generator connected to a 12 x 12-in. Payne Engine.

20-Kw., 125 volt General Electric Generator connected to a 9 x 7-in. Vertical Engine.

Belted

250-Kw., 250 volt Westinghouse Generator.
125-Kw., 250 volt Western Electric.
60-Kw., 125 volt Westinghouse.
30-Kw., 125 volt General Electric.

Also Motors all sizes.

Wickes Machinery Company
Jersey City, N. J.

FOR SALE—*IMMEDIATE DELIVERY*

TRANSFORMERS

Used for a short time at Camp Stuart, Newport News, Va., are in excellent condition and will be furnished with hangers

WESTINGHOUSE "TYPE P"

Kva.	H.T.	Lt.	Cycle
1	2200	110-220	50-140
5	2200	110-220	60
7½	2200	110-220	50-140
10	2200	110-220	60
15	2200	110-220	60

PITTSBURGH

2	2200	110-220	60
5	2200	110-220	50-133
15	2200	110-220	50-133
15	2200	110-220	60
20	2200	110-220	60
25	2200	110-220	60
375	22,000-11,000	2300	60
400	22,000-11,000	2300	60

"GEN. ELEC." CONSTANT CUR. Type "RO"

			Amp.
4	2300	60	6.6
8	2300	60	6.6

"PACKARD" TYPE "A"

3-k., 60-Cycle, P.V. 3300, Amp. 6.6.

Transformer, 1674 Adjuster Coil, A.W., 1674

15	3300	115-230	60
100	2200	110-220	60

"GENERAL ELECTRIC" TYPE "H"

Kva.	Ht.	Lt.	Cycle
5	2200	110-220	60
7½	2200	110-220	60
10	2200	110-220	60
15	2200	110-220	60
20	2200	110-220	60
25	2200	110-220	60
2	3300	122-244	60
7½	3300	122-244	60
10	3300	122-244	60
10	1560-3120	115-230	60
15	3300	122-244	60
25	3300	122-244	60
30	3300	122-244	60
37½	1560-3120	115-230	60

"MOLONEY" TYPE "HE"

2	3300	110-220	60
7½	3300	110-220	60
7½	1150-2300	115-230	60
15	1150-2200	110-220	60
15	1150-2300	115-230	60
15	1650-3300	115-230	60
15	1650-3300	120-240	60
20	4000	110-220	60

"WAGNER" TYPE "HE"

15	2200	110-220	60

Also the Following ELECTRICAL MATERIALS in Large Quantities

Adjusters	Brace Arms	Cutter Boxes	Clamps	Cutouts	Switches
Arresters	Brackets	Condulets	Fixtures	Plugs	Wire
Break Arms	Bolts	Lamp Cord	Insulators	Sockets	Poles
Bases	Cross Arms	Cleats	Lamps		

Write for detailed list and prices

ATLANTIC SALVAGE CO., Newport News, Va.

ELECTRICAL UNIT BARGAIN

Westinghouse 400 KW. Generator, 3-phase, 25 cycles, A.C., 220 volts, 136 R.P.M., serial 201925, with flywheel 11 in. x 14 ft., direct connected to cross compound Brown, heavy duty Corliss engine, 18 in. diameter piston by 36-in. stroke.

The above is in first-class second-hand condition.

For further information apply

J. P. NOONAN
816 Union Arcade Bldg.
Pittsburgh, Pa.

FOR SALE

1—500 kw.

WESTINGHOUSE HARRISBURG UNIT

1—500 hp.

WESTINGHOUSE MOTOR

2-phase, 60-cycle, 440-volt, type C.S.

1—250 kw.

MACKINTOSH TANDEM COMPOUND ENGINE

1—62½ kw. D.C.

WESTINGHOUSE CROSS COMPOUND ENGINE

THE B. F. GOODRICH CO.
AKRON, OHIO.

Notice to Advertisers

Owing to the coming holiday, the Searchlight Section of the July 3 issue will close for press earlier. All changes of copy must be in our hands by 10 A.M., Monday, June 28.

Mail your copy as early as possible to insure its appearing in the issue desired.

The following apparatus for sale at the plant of

PAUL GUENTHER, Inc.
Dover, New Jersey

1—Westinghouse 75 K.W. 3 wire, 125/250 volt direct current belt Generator operating at 580 R.P.M., condition good as new, complete with pulley rail base and rheostat. Immediate delivery.

FOR SALE

WESTINGHOUSE ALTERNATOR

1—300-kw., 220-v., 3-phase, 60-cycle, 514 r.p.m., belt driven, with belt driven exciter.

WESTINGHOUSE SYNCHRONOUS MOTOR

1—100 KVA., 220-v., 3-phase, 60-cycle, 900 r.p.m., complete with pulley, starting panel and belt driven exciter. Excellent condition. Immediate delivery. Located in Baltimore, Md. Further particulars on application.

H. EGLI
425 Courtland Street, Baltimore, Md.

PROMPT DELIVERY

2—650-kva., 150 r.p.m., 48-pole, 2400-volt, 156 amperes, 60-cycle, 3-phase, vertical type Generators, complete with bases, shafts, steady bearing and field rheostats.

1—50-kw., 450 r.p.m., 125-volt, vertical type exciter, complete with base, shaft, thrust bearing above and steady bearing below, and field rheostat.

For details and very attractive prices, write us.

VERTICAL ALTERNATORS & EXCITERS
The F. Bissell Co., Toledo, Ohio, U.S.A.

---

500 H.P. B. & W. CHAIN GRATE STOKER

1—500 H.P. B. & W. Chain Grate Stoker, built for 500 H.P. B. & W. Water Tube Boiler. Complete and in strictly first class condition. A special bargain.

PAUL STEWART AND COMPANY
First National Bank Bldg, Cincinnati, Ohio.

FOR SALE

TRANSFORMER STATION

3—200 kva. Transformers, G.E., 60-cycle, Type H., Form K. D. D., 6600 to 13,200 v., 2300 to 2013 v.
1—3 Panel Indoor Switch, with oil switches, Type E, 8 Ammes 100-volt 2500-Ground Detector, Three Phase Electrostatic G. E. Voltmeters.
2—Ammeters—Current Transformers for each oil switch.
Also 12,000 lb. No. 2 Triple Braid Copper Wire.
1—33 Switch Theatre Switch Board.
2—2 kw. Constant Current Transformer, 2300 volts, 60-cycle, Gen. Elec. Co.
1—1 kw. Constant Current Transformer, 2300 volts, 60-cycle, Gen. Elec. Co.
6—Non-Auto pole line oil switches, 4500 volts, 60-cycle.
16—Lightning arresters, Westinghouse, type C.R. for pole.

J. P. MULHERIN, CAMP HANCOCK, AUGUSTA, GA.

IMMEDIATE DELIVERY

1—1875 kva. Westinghouse

LOW OR MIXED PRESSURE TURBINE

3 phase, 60 cycle, 2300 volts, 1800 rpm., complete with condensing apparatus and complete spray cooling system, generator panel and all fittings.

Wire or Write

John A. Stewart Electric Co.
408 First National Bank Bldg.,
Cincinnati, Ohio

FOR SALE
Generating Unit

1—200 kw., nearly new, 30-cycle, 3-phase, 220-volt A.C. Westinghouse generator direct connected to a Buckeye R H tandem compound engine complete with switchboard and exciter.

U. S. GYPSUM CO.
Oakfield, N. Y.

10—New Turbo Sets

50 kw. Westinghouse 3 phase, 60 cycle, 220 volts direct connected to

WESTINGHOUSE TURBINES

Immediate Delivery

Also ful line of Motors, Generators, Engines, Boilers, Iron and Woodworking Machinery and Contractors' Equipment.

L. F. SEYFERT'S SONS, Inc.
437 N. Third St., Philadelphia, Pa.

Single Phase Motors

65—2 hp., NEW, Wagner, 1700 r.p.m., 60 cycle, 110/220 vo.
85—3 hp., NEW, Wagner, 1700 r.p.m., 60 cycle, 110/220 vo.
Less 10% to dealers.
100—¼ hp., slightly used, 3 phase, 60 cycle, 220 vo., 1700 r.p.m., Westinghouse and Fidelity.
Less 10% to dealers.

NATHAN KLEIN & CO.
Howard and Centre Sts., New York

KNIFE SWITCHES

100—3-pole knife switches. All sizes.

CIRCUIT BREAKERS

60—alternating circuit breakers.

NATHAN KLEIN & CO.
Howard and Centre Sts., New York

WIRING MOTORS
SIGN OF O B QUALITY
FIXTURES REPAIRS

Motor repairs on all makes of motors and generators.

Ship your repairs to us.

Write for a complete list of motors in stock for immediate shipment.

Olson-Boettger Elec. Mfg. Co.
St. Paul, Minn.

WORTH KNOWING

DID IT EVER OCCUR TO YOU that when your MOTORS and DYNAMOS go wrong it's worth money to you to know the right place to get them put in shape *promptly* and at the *right price?*

We manufacture DYNAMOS and MOTORS and also carry a line of USED MOTORS, including both Alternating and Direct Current.

THE HOLT ELECTRIC CO.
377-379 South Pierce St., Milwaukee, Wis.
Phone Hanover 519

Kansas City Armature Works

Equipped for any
Electrical Machinery Repairs
Mining and Locomotive Armatures
Rewound, A. C. Windings

Kansas City, Mo.

Get your Wants into the Searchlight

Electrical Engineers, Electrical Power Equipment and Central Station Repairs, Meters and Transformers.

W. N. ALBERTSON & COMPANY
Milwaukee, Wis.

Motors and Generators

New and guaranteed used apparatus, bought, sold, repaired.

The Electric Motor & Repair Co.
Akron, Ohio

BOUSTEAD ELEC. & MFG. CO.

Switchboards

New and Used Electrical Machinery

Winding and Repairing

16-18 E. Hennepin Ave.
MINNEAPOLIS, MINN.

WORRYLESS ELECTRICAL REPAIRS

On all kinds and sizes A.C. or D.C. motors and generators, starters, welders, controllers, or anything electrical. Quick shipment; from stock material, of coils commutators—shafts—bearings, etc. **Remember our initials stand for our product.**

CAREFUL CLEVELAND ACCURATE ARMATURE WORRYLESS WORKS, Inc.

EST. 1895 **4732-4-6 ST. CLAIR AVE., CLEVELAND** **INC. 1918**

NEW and USED

Motors and Generators

BOUGHT — SOLD — REPAIRED

ARTHUR JONES ELECTRIC COMPANY
Chicago 2837 S. State St. **U. S. A.**

LIGHTING PLANT FOR SALE

1—100-hp., Fairbanks-Morse Oil Engine, 2 cy., 4-cycle, directly connected with alternator (Fairbanks-Morse Electrical Mfg. Co.) KVA 75, Type D-450, 2300-volt, 3-phase, speed 257, 60-cycle, amperes per phase 18.8, No. 25,653.
1—50-hp. same make as above, directly connected alternator, KVA, 37½A, Type D, 2300-volts, 3-phase, amperes per phase, 9.4, speed 300, 60-cycle, No. 34,415 Frame Size D-400A.
2—Direct Current Dynamos, same make as above, KW 5, 115-volt, ampere 43.5 type FR adjustable for 1000 R.P.M. no load 110-volt, loader 115-v.
1—Complete switchboard connected.
1—Air compressor and 2 air tanks.
1—2½-hp. Gas Engine.
1—Circulating Pump.
1—Large Oil Tank ½-in. steel 1 car load capacity.

Wire for option for inspection

The VICTOR L. PHILLIPS Co.
7th and Delaware Streets
Kansas City, Mo.

General Electric and Centrifugal COMPRESSORS

1—111 Set, 1600 cu.ft. capacity at 1 lb. pressure, fitted with 10 hp., 220 volt, 60-cycle, 3-phase motor, complete with Compensator and Blast Gate. Price $800.
1—112 Set, 3200 cu.ft. capacity at 1 lb. pressure, fitted with 20 hp., 220 volt, 60-cycle, 3-phase motor, complete with Compensator and Blast Gate. Price $1000.
1—130 Set, 1000 cu.ft. capacity at 1½ lb. pressure, fitted with 10 hp., 550 volt, 60-cycle, 3-phase motor, complete with Compensator and Blast Gate. Price $700.

These machines have not been used over six months and are absolutely in first-class condition

THE LAMSON COMPANY
100 Boylston St., Boston, Mass.

FOR SALE

DIESEL OIL ENGINE WITH DIRECT COUPLED A. C. GENERATOR

Engine—500 hp. capacity.
Generator—General Electric Co., 380 kw. capacity.

Including all auxiliary equipment for engine, and control equipment for generator.

Outfit is new, never having been uncrated. Ready for immediate shipment.

For Full Details, Write

Electrical Engineer
Pressed Steel Car Company
Farmers Bank Building
Pittsburgh Pa.

Gasoline Engine Generating Set

Western Electric Company make 8 to 10 hp., 5 kw., 40 amperes, 125 volts, including gasolene engine, constant current generator, switchboard, storage jars and plates, etc., for sale; used very slightly; installed 1915; but not used for four years, recently overhauled; make offer. Deliver immediately F.O.B. Port Jervis, N. Y. Inspection invited; bargain for somebody.

Address Owner, 1713, 1480 Broadway, New York.

FOR SALE

1—300 Kw., 250 volt, 1200 amperes, 8-pole, compound wound, Crocker-Wheeler D.C. generator d.c. to 18 x 30 x 42 Vilter horizontal cross compound heavy duty Corliss engine, 100 r.p.m. Immediate shipment, Chicago stock.
1—400 Kva., 3-phase, 60-cycle, 2300 volt or 440 volt Allis-Chalmers alternator, 150 r.p.m., d.c. to 24 x 30 brand new Chuse non-releasing Corliss type engine. Belted exciter and switchboard panel. Shipment June 1st.

POWER EQUIPMENT COMPANY
Fisher Bldg., Chicago, Ill.

FOR SALE

ARC LAMPS

104—Westinghouse 4 ampere D.C. metallic flame
Good Condition

INDIANA POWER CO.
Vincennes, Indiana

FANS FANS

200—12-in. and 16-in. 220 volt, A.C. Desk Fans, also
150—12-in. Oscillating 110 volts, A.C. Fans.
Fans are new in original crates. Prices very low.

EXCHANGE ELECTRIC MOTOR CO.
231 Centre St., New York, N. Y.
Phone Canal 5388W.

FOR SALE

1—90 kw. belted type
General Electric Generator
2500 volt, single phase, 60 cycle, 750 r.p.m. Complete with Exciter. Good as new.
Price $500 f.o.b.

Southwest Power Machinery Exchange
Oklahoma City, Okla.

Conduit Pipe For Sale

We offer 30,000 ft. ½ in. and ¾ in. galvanized conduit pipe used for government work, has been installed but has not been used; lengths 7 to 12 ft. with threads and couplings. A portion of same has been painted. Will sell all or part.

Marine Metal & Supply Co.
167 South Street, New York City

FOR SALE

NEW
Murphy Stoker

adapted to 300 H.P., V. W. T. Wickes Boiler.

Immediate Shipment

THEO. KUNDTZ CO.
***Pur. Dept.*, Cleveland, O.**

Keep Your Eyes on the Searchlight Section and your Ad in it

For Sale—73—8-in. x 8-in. x 48-in.
GRAPHITE ELECTRODES
900
USED CARBIDE CANS
With new covers. All in good condition.

Address Rochester Gas & Electric Corp.
Rochester, N. Y.

New Motor For Sale

1—20 hp. General Electric Vertical Motor, 2200 volt, 3 phase, 60 cycle, 900 r.p.m. with starting Compensator, 20% below list.

Southwest Power Machinery Exchange
Oklahoma City, Okla.

25-CYCLE, 3-PHASE MOTORS

IMMEDIATE SHIPMENT — *BRAND NEW*

Available	*H.P.*	*Volts*	*Speed*	*Make*	*Type*
1	7½	220	750 r.p.m.	General Electric	KT
3	7½	220	1500 r.p.m.	General Electric	KT
5	7½	440	1500 r.p.m.	General Electric	KT
4	10	220	750 r.p.m.	General Electric	KT
1	15	440	750 r.p.m.	General Electric	KT
3	15	220	1500 r.p.m.	General Electric	KT
2	20	440	750 r.p.m.	General Electric	KT
1	25	440	750 r.p.m.	General Electric	KT

RALPH E. GARRITY CO., 607 Wabash Building, Pittsburgh, Pa.

MOTOR GENERATOR SET

Hawthorn D.C. Motor, shunt wound, type E.L.C.-9, 70 amp., 250 volts, 45-hp., speed 700, direct connected to D.C. Generator, type E.L.C.-9, 25-kw., 416 amp., 60 volts, complete with switchboard. Only slightly used.

Alignum Fireproof Products Co., Inc.
South River, N. J.

FOR SALE

Generator Switchboard Panels—2 excellent, 500 Kw. Standard General Electric capacity panels complete in every respect including solenoid operated oil circuit breakers, all instruments current and potential transformers. Mounted on blue Vermont marbie. Price, $300 each.

R. L. Baker
30 North La Salle Street, Chicago, Ill.

2—200-kw. **Crocker-Wheeler Generators,** direct connected to Buckeye engine, 500-volt D.C. or 250-volt D.C. Complete with panels, meters, rheostats, etc.
1—15-kw., 125-volt, 120 amp. **Westinghouse Generator.** Complete with panel, meters, etc., 1 extra armature.
1—20-kw., 125-volt **Lighting Set,** 160 amp. Complete with panels, meters, etc. The 15 and 20-kw. sets are equipped with Westinghouse standard engines.
2—150-hp. **Bullock Motors,** 500-volt, 750 r.p.m. Complete with slide rail bases, pulleys and starters.
2—200-hp., 690 r.p.m. **A. C. Motors,** 2200-volt. Complete with slide rail base and pulleys and starters. Out bored bearings. All for immediate delivery, F.O.B. cars Pittsburgh.

H. R. EICHER
701 House Bldg., Pittsburgh, Pa.

TRANSFORMERS

14—265 k.w., General Electric, type AB, 40-cycle Transformers; 3120 volts primary, 575 volts secondary.

In excellent condition, equal to new. Will sell one or all at attractive prices.

POWER EQUIPMENT CO.
Engineers
1809 Buttonwood St., Philadelphia, Pa.

MACHINERY WANTED MISCELLANEOUS

WANTED GOOD

ELECTRIC MOTORS

ANY SIZE, KIND OR QUANTITY

Write full particulars, and lowest spot cash prices.

NATHAN KLEIN & CO.
Howard and Centre Sts., New York

WANTED

25-CYCLE GENERATORS

Steam driven or belted. Preferably 2300 volts in large sizes.

600 volts in small units.

Please write.

W205—Electrical World
10th Ave. at 36th St., New York City

Transformers Wanted

3—200 kva., 11,000/2300 volt, 60 cycle outdoor transformers, give details and price.

E. R. TREVERTON, City Manager
Rock Hill, S. C.

WANTED

MOTOR

1—250 H.P., 440 R.P.M., 25-Cycle, 440-Volt Slip Rign Motor.

W. A. CARRELL & CO.
211-13-15 Second Avenue, Pittsburgh, Pa.

WANTED

Engine Sets, Generators, Rotaries, Transformers, Motor-Generator Sets, Meters, A.C. & D.C. Motors

Send us list of electrical equipment that you have for sale, and let us make you an offer.

The Electric Service Co.
212 Walnut St., Cincinnati, Ohio

Get YOUR *wants into the* SEARCHLIGHT

0084

MACHINERY **WANTED** MISCELLANEOUS

WANTED AT ONCE

Transformers

3—750 K.V.A. or 3 1000 K.V.A. Taylor connected, 33,000 volts, 3-phase, 60 cycles to 2,400 volts, 2-phase, 60 cycles.

Or

2—1,000 K.V.A. or 2 1,500 K.V.A. Scott connected for above voltages.

Municipal Electric Light Plant
Hagerstown, Md.

WANTED IMMEDIATELY

1—200 hp., 2 or 3 phase, 220 or 440 volt, 60 cycle, 720 r.p.m.

SLIP RING OR SQUIRREL CAGE MOTOR

complete with starting device, without pulley or base, giving price and delivery.

Communicate at once with the Purchasing Agent of the

UTICA GAS & ELECTRIC COMPANY
222 Genesee Street, Utica, New York

CASH FOR PLATINUM

Ship to us by mail or express, any small or large amount of platinum, in any shape or form. We buy new or old contact points, wire, etc., anything containing platinum. We also buy anything containing gold or silver, such as scrap, new or broken jewelry, silverware, gold crowns and bridges, in fact anything containing the precious metals. Ship now. Cash sent to you same day as goods received, by registered mail. Goods returned in 10 days, upon return of cash, if you're not satisfied. Highest market prices paid. Bank and trade references. We buy Mercury.

THE OHIO SMELTING AND REFINING COMPANY
290 Lennox Bldg., Ninth and Euclid
Cleveland, Ohio

WANTED—TO PURCHASE

one 5,000 to 6,000 k.w., 3-phase, 60-cycle, 2300-volt

TURBO GENERATOR AND CONDENSER

either used or machine on order. Give complete description of machine including steam pressure, superheat, power factor and other rating details as well as year machine was built.

W195—Electrical World
1570 Old Colony Bldg., Chicago, Ill.

WANTED

300-kw. 60-cyc., 2,300-v. alternator, 3-phase, direct connected to Corliss, NRC, or 4-valve engine, complete with exciter and switchboard. Must be in first-class condition.

Steel stack, 66-in. diameter, 125 ft. long, or equivalent.

FOR SALE

90-kva. GE alternator, 60-cyc., 2,300-v., 3-ph. direct connected to Chuse Uni-flow engine. This set has been in operation only two years and is as good as new.

PROBST PURE PRODUCTS CO.,
New Athens, Ill.

WANTED IMMEDIATELY

two 1000 H.P., 3-phase, 80 cycles, 240 R.P.M., 2200 Volts,

SYNCHRONOUS MOTORS

suitable for direct connection.

Carthage Sulphite Pulp & Paper Co.
Carthage, N. Y.

WANTED

1500 to 5000 kw.

TURBO ALTERNATOR

60 cycle, 2300 volt, 3 phase, surface condenser, air and condensate pumps.

States Steam Economics

New Brunswick Power Co.
St. John, N. B.

WANTED

Two Transformers

60-CYCLE, 50 KVA. EACH
(Or will accept 37½ or 75 KVA.)
2,200 volts to 440 volts.

With taps to give Scott connection for transforming from 2-phase high tension to 3-phase low tension.

Will consider proposal for 3 transformers if each one has taps for both 50% and 86.6% so that any transformer can be used in either position of the Scott connection. State price, location, make, type and serial numbers.

CHARLES WARNER COMPANY
Wilmington, Delaware

WANTED

PIN TYPE

INSULATORS

Suitable for operation at 11,000, 23,000, 33,000, 44,000 volts.

Insulators from Power Company lines which are being converted to higher voltage operation, if in satisfactory condition, will be acceptable.

VIELÉ, BLACKWELL & BUCK
49 Wall Street, New York City

Notice to Advertisers

Owing to the coming holiday, the Searchlight Section of the July 3 issue will close for press earlier. All changes of copy must be in our hands by 10 A.M., Monday, June 28.

Mail your copy as early as possible to insure its appearing in the issue desired.

ELECTRICAL WORLD

Think "SEARCHLIGHT" First

ADVERTISING RATES

POSITIONS VACANT—Business Opportunities and other undisplayed ads, 8 cents a word, minimum $2.00 an insertion.

POSITIONS WANTED—Evening work wanted, tutoring and other undisplayed ads of individuals looking for employment, 4 cents a word, minimum 75 cents, payable in advance.

ADD 5 WORDS for box number in undisplayed ads if replies are to any of our offices. There is no extra charge for forwarding replies.

DISCOUNT OF 10% if one payment is made in advance for 4 consecutive insertions of undisplayed ad.

ADS IN DISPLAY TYPE—Space is sold by the inch (30 in. to a page), the price depending upon total space used within a year, some space to be used each issue.

RATE PER INCH for ads in display space:

1 to 3 in., $5.00 an in.	15 to 29 in., $4.50 an in.
4 to 7 in., $4.80 an in.	30 to 49 in., $4.40 an in.
8 to 14 in., $4.60 an in.	50 to 99 in., $4.20 an in.

POSITIONS VACANT — EMPLOYMENT — POSITIONS WANTED

FOR SALE

Blueprints

Electrical Connections. Alternating and Direct Current Motors, Transformers, Rheostats, Controllers, Compensators, Automobile generator armatures. 10 samples A.C. 25c. Catalog Free. Charles Chittenden, W3024 Matthews, Kansas City, Missouri.

Modern D.C. Electric Light Plant For Sale

Diesel oil engine with starter; 10,000 gallon storage tank; 100 consumers and growing; 20-cent kw. rate; progressive 1,000 population. Public Service, Mattoon, Wis.

Easterline Graphic Wattmeters For Sale

Two Type WAL. Rating 10 amp. 100 volts, without transformers, glass cases. Used one week; same as new; $80 each. Albion Electric Co., Albion, Illinois.

Seven Lalley Farm Lighting Plants

For Sale at once. Late 1919 models and in original boxes. Must sell, owing to dissolving partnership. Two demonstrators included in the above number, but are o. k. Will make flat price on the whole lot. P.-B. Electric Co., Milford, Ill.

POSITIONS VACANT

ARMATURE winder wanted experienced on large A.C. and D.C. station machines. State experience, also wages wanted. Address, Superintendent Electric Repairs, Los Angeles Railway Corporation, Los Angeles, California.

POSITIONS VACANT

AUDITOR-ACCOUNTANTS—Several with broad accounting experience and of executive ability wanted by large public utility corporation for executive and staff positions, with salaries ranging upwards of $3,000, depending upon applicant's probable worth; give full particulars as to age, education, experience, references and salary expected. Address P-197, Electrical World.

CENTRAL station company in the Middle West is seeking applications from men who desire electrical operating positions. To qualify men must be 21 years of age and have some correspondence school or equivalent training in electrical engineering. Company has prescribed methods of training men in this work with excellent opportunities for promotion. Starting rates, $125 per month. In replying state qualifications. P-961, Elec. World, Old Colony Bldg., Chicago.

ELECTRICAL operators wanted; state age and experience; 8 hours a day; $150 per month. P-142, Elec. World, Old Colony Bldg., Chicago.

ELECTRICAL draftsmen wanted: Several by large construction firm building power stations in Central West. Will pay $1,800 to $2,400 for men with experience in electrical design in connection with power stations, according to ability. Address, giving age, education, experience and salary expected, P-901, Elec World, Old Colony Bldg., Chicago.

CENTRAL-OFFICE engineers: The expansion of our engineering force presents an unusual opportunity to electrical and telephone engineers who want to rise in their professions, and to practical men who are capable of becoming engineers.

POSITIONS VACANT

A Vestibule Training Department has been established for training practical telephone men or men with technical education who have not had experience in telephone engineering. Instruction work is given during working hours and the engineer has the advantage of earning while learning and being helped to advance step by step to higher positions. The central office engineer prepares complete information in the form of specifications and drawings for the manufacture and installation of telephone central office equipment. He does no drafting, but furnishes the drafting department with the information for making the drawings. It is his duty to settle all engineering questions which may arise in the manufacture and installation of the equipment. Call or write, giving age, experience and salary expected. P-185, Elec. World, Old Colony Bldg., Chicago.

DRAFTSMEN wanted for the Panama Canal: 1 electrical draftsman familiar with fire control of coast artillery; 1 marine hull draftsman thoroughly experienced in general ship construction and repairs, capable of laying out and developing work from specifications; 2 draftsmen, mechanical engineering graduates class 1920, and 2 draftsmen, naval architecture, graduates class 1920. Applicants must be American citizens (final papers), under 50 years of age, in good health. Free transportation from New York or New Orleans, salary beginning date of sailing. No civil service examination required. Write, Chief of Office, The Panama Canal, Washington, D. C.

ENGINEER for Diesel oil engine, 225 hp., in conjunction with hydro-electric plant. State age and experience. P-151, Elec. World.

POWER *and* MAINTENANCE EXECUTIVE

Competent to Supervise Power Equipment and Plant Maintenance

One who is thoroughly familiar with steam and electrical engineering and construction work. A man of pleasing personality who thoroughly understands his work and can impart this information to others. This is a high-grade position and offers unusual opportunity to the man who can qualify. We prefer a man now employed who is desirous of bettering his conditions by a change. Write, giving full particulars regarding experience and training, accompanied by a photograph, to

P189—Electrical World
Leader-News Bldg., Cleveland, Ohio.

WANTED

Chief Inspector

One of our clients, a manufacturer of electrical appliances, has an opening for a Chief Inspector. He must be over 35 years of age, a keen executive, and, above all, must know this class of work thoroughly. An initial salary of $300 per month will be paid. Write us for particulars. All communications will be kept confidential.

CONSOLIDATED AGENCIES
110 S. Dearborn St., Chicago, Illinois

Testing Laboratory. A position as assistant to engineer in charge of one of the best known electrical laboratories in the country is open to a technical engineer of several years' laboratory experience. Principle duties will be to supervise the experimental and development work of the Laboratory. This work is chiefly on electrical measuring devices. Salary commensurate with experience and ability. Location, New England.

P194—Electrical World,
10th Ave. at 36th St., New York City.

POSITIONS VACANT

EXPERIENCED electric substation operators wanted having a technical training and capable of promotion; state experience, education and salary expected. P-167, Elec. World, Old Colony Bldg., Chicago.

EXPERIENCED foreman wanted for test room; must be familiar with testing alternating current and direct current motors and generators. Permanent position for right man. Write, giving age, education and practical experience. P-196, Elec. World, Old Colony Bldg., Chicago.

FIRST CLASS man wanted to take charge of up-to-date repair shop; must thoroughly understand all classes of A.C. and D.C. winding, connecting, etc., also be able to take charge of entire electrical and mechanical work in shop and handle men. P-175, Elec. World.

FOREMAN coil winder wanted—Man who is thoroughly experienced in winding and building of all classes of armature, field and transformer coils, and who is competent to take charge of coil winding department. Salary $60.00 per week to start. Permanent position with excellent opportunity for advancement. State details of experience, companies for whom you have done similar work, age, and complete information in first letter. The Electric Service Co., 212 Walnut Street, Cincinnati, Ohio.

FOREMAN wanted for electrical repair shop employing fifteen to eighteen men. Northeastern Pennsylvania. P-190, Elec. World, Real Estate Trust Bldg., Philadelphia.

GENERAL superintendent wanted: Must be experienced in street railway, power plant and electric distribution; Southern city of 30,000. State experience and salary wanted. P-193, Elec. World, Old Colony Bldg., Chicago.

GENERAL electrical repairmen with experience in transformers and rotaries wanted by large interurban railway company in Illinois; will live at home; steady employment, good opportunities. Apply at once to Electrical Department, Illinois Traction System, Springfield, Illinois.

MANUFACTURING plant in southern Pennsylvania desires the services of a high-class electrician; one who can keep motors, windings, bearings, etc., in first-class condition, make power tests, maintain present equipment and install all new wiring, motors, etc. Highest salary to qualified applicant. Give age, experience, etc., in first letter. P-181, Elec. World, Real Estate Trust Bldg., Philadelphia.

METERMAN—Competent to install, repair, test and maintain all makes of meters and instruments, including integrating, graphic and demand meters; give full particulars as to experience, age, salary, and when available. P-199, Elec. World, Real Estate Trust Bldg., Phila.

In Replying to "Blind" Ads

be careful to put on envelope the key number in the ad. and also local address of office to which reply is sent.

10th Ave. at 36th St., New York.
1570 Old Colony Bldg., Chicago.
533 Leader-News Bldg., Cleveland.
935 Real Estate Trust Bldg., Phila.
531 Rialto Bldg., San Francisco.

Important

Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents—send copies.

POSITIONS VACANT

POWER and maintenance executive, competent to supervise power equipment and plant maintenance. One who is thoroughly familiar with steam and electrical engineering and construction work. A man of pleasing personality who thoroughly understands his work and can impart this information to others. This is a high-grade position and offers unusual opportunity to the man who can qualify. We prefer a man now employed who is desirous of bettering his conditions by a change. Write, giving full particulars regarding experience and training, accompanied by a photograph. P-192, Elec. World, Leader-News Bldg., Cleveland.

SUBSTATION operators wanted; 8 hour shifts and good working conditions; $150 per month; applicant must be at least 21 years of age and must be able to handle synchronous motor generator sets; state experience and when available; location near Chicago. P-154, Elec. World, Old Colony Bldg., Chicago.

TRANSFORMER designer wanted for Sydney, Australia; good opportunity, permanent position, expenses paid. State age, experience and salary required. S. N. Clarkson, 1570 Old Colony Bldg., Chicago.

EMPLOYMENT SERVICE

EXECUTIVES qualified for salaries of $2,500 to $25,000 and upwards, are invited to communicate in strict confidence with the undersigned, who will conduct preliminary negotiations for such positions. The procedure used is peculiar to this service, differing essentially from all others; and is constructive and initiative; applied individually; and in no way jeopardizing present connections. Established 1910. Send name and address only for particulars. R. W. Bixby, Inc., 310 Lockwood Building, Buffalo, New York.

Electrical Engineers, Designers and Superintendents

We make a specialty of finding suitable positions for qualified men of this kind. Write for particulars. No advance charge.

H. H. HARRISON & CO.
Confidential Employment Service
19 So. LaSalle St., Chicago.

POSITIONS WANTED

CHIEF Clerk, thoroughly experienced in handling the public, several years' experience with water, gas and electricity, wishes to locate permanently; capable of taking complete charge of office. Would consider position as traveling auditor. PW-209, Elec. World, Old Colony Bldg., Chicago.

DO you need a technically trained electrical engineer with twelve years' experience in operation and maintenance of electrical machinery, armature winding, storage batteries, and power plant machinery? Age 29; married; good references; good reasons for leaving present position; present salary $200 and house; desires position as assistant electrical engineer or chief electrician in industrial plant or electrical repair shop; minimum salary $250 plus a future; available September 1st. PW-202, Elec. World, Old Colony Bldg., Chicago.

ELECTRICAL engineer, technical graduate, age 34; non-superintendent public utility; 12 years experience covering design, construction, operation and supervision of transmission and distribution systems, stations, and properties. Available for utility or industrial proposition; East preferred. PW-147, Elec. World, Old Colony Bldg., Chicago.

ELECTRICAL engineer, technical graduate, age 31, 10 years' experience covering design, construction, operation and supervision of electrical work, with power and industrial companies, available at once for utility or industrial proposition; salary $3,000; East preferred. PW-174, Elec. World, Real Estate Trust Bldg., Phila.

ELECTRICAL engineer, 32, university graduate, 9 years' experience in design, construction, distribution of power plants, desires engineering position. PW-172, Elec. World.

ELECTRICAL engineer, age 31, college man, eight years' experienc on small motors, generators, magnetos, automobile electrical equipment, desires position. PW-173, Elec. World.

ELECTRICAL engineer, Cornell graduate; 18 years' experience in industrial and power plant engineering and construction, desires to locate in West. PW-182, Elec. World, Old Colony Bldg., Chicago.

ELECTRICAL graduate, practical electrician, good on installation, operation, maintenance and repair of D.C. and A.C. motors, starting boxes, wiring, etc.; 15 years' experience; desires responsible position, and prefer location in a small city or rural community with living conditions suitable for married man with family. What have you to offer? PW-183, Elec. World, Real Estate Trust Bldg., Philadelphia.

THE NEW YORK EDISON COMPANY

has vacancies for experienced

ELECTRICAL DRAFTSMEN

on power and sub-station layouts. Excellent training offered men with originality. Permanent positions. If qualified write for an interview.

P-184 Electrical World
10th Ave. at 36th St., New York City

WANTED

Several Experienced Mechanical and Electrical Draftsmen

More particularly those having experience in transformers, A.C., and D.C. generators and motors. In applying, state previous experience, where at present employed, and salary expected.

Apply Works' Engineer Canadian General Electric Company, Peterboro, Ont., Canada.

POSITIONS WANTED

ELECTRICAL engineer, large experience in design, construction and operation. Now in responsible position but desires change in line with above experience or with opportunity to work into management. Member W. S. E. PW-191, Elec. World, Old Colony Bldg., Chicago.

ELECTRICAL engineer, university graduate, experienced in research work, development and design of automotive electrical equipment and motor controlling devices (electric railways) desires position where high grade engineering ability is required; has held responsible executive position. PW-203, Elec. World.

ELECTRICAL engineer — Industrial plant specialist; electric plants, distribution systems, transformer stations and complete equipment designed. PW-204, Elec. World.

ELECTRICAL engineer—Recent technical graduate; have had two years of practical electrical work besides several years of varied experience, including machine shop, carpenter and concrete work; have had experience in handling men; at present am assistant construction engineer in the Middle West; am not afraid of hard work; will locate anywhere; available on short notice. PW-198, Elec. World, Leader-News Bldg., Cleveland.

ELECTRICAL engineer,, 16 years' power and industrial plant construction and maintenance, some design and drafting, present employed as plant engineer, desires change. PW-200, Elec. World.

ELECTRICAL engineer, 16 years' power and industrial plant construction and maintenance; some design and drafting. Present employed as plant engineer, desires change. PW-206, Elec. World.

ENGINEER wishes change; electrical experience up to 2,300 volts; mill or power house considered; no refrigeration; Kansas City. PW-210, Elec. World, Old Colony Bldg., Chicago.

METERMAN, experienced in testing and repairing all types of watthour meters, large polyphase and demand meter, desires position; West preferred. PW-211, Elec. World, Old Colony Bldg., Chicago.

RECENT E.E. graduate, 25, desires engineering position with opportunity of working into one of responsibility later; location anywhere in the East; little experience but good education; give me a chance to show what I can do. PW-201, Elec. World, Real Estate Trust Bldg., Philadelphia.

SUPERINTENDENT of construction, 17 years' experience including operation, construction and design of industrial and power plants. PW-187, Elec. World.

SUPERINTENDENT or manager of electric property by technical graduate whose ten years' experience embraces sales, production, transmission and distribution; high-class references; at present employed. Age 33, married. PW-212, Elec. World, Real Estate Trust Bldg., Philadelphia.

TWENTY-FIVE years' practical experience with electric light and power, boilers, engines, generators, switchboards, motors, transformers, meters, construction of high tension and distribution lines, substations, development of new business, office work in connection; can take full charge of municipal water works, and supervise general carpentry, masonry, concrete and machine work. Prefer position in Middle West, and will take interest on partial payment plan; married, strictly temperate and reliable; salary $300.00. PW-207, Elec. World, Old Colony Bldg., Chicago.

YOUNG man, age 24, wants position along electrical engineering lines; have 6 years' practical experience, also I. C. S. electrical graduate; experienced in armature winding, testing, trouble shooting, general repairing, building and maintenance; location immaterial. PW-188, Elec. World, Leader-News Bldg., Cleveland.

POSITIONS WANTED

YOUNG man at present occupying an executive position in a large electrical manufacturing company wishes to become identified with an electrical company in New York City. PW-208, Elec. World.

YOUNG electrician desires employment where he can acquire experience; willing to commence at bottom. T. J. Higgins, Woodford, Va.

EXTRA WORK WANTED

DRAFTSMAN of broad experience desires part time work on an hourly basis in New York or vicinity. Electrical, mechanical, civil engineering, drawing. Also perspective sketches for illustrations, etc. XW-122, Elec. World.

WORK WANTED

TECHNICAL translsations a specialty—French, Spanish, Italian, German. Correspondence prompt and accurate. Elite Translation Bureau, 75 West 92nd St., New York City.

AGENTS AND SALESMEN

Salesman Wanted

To build up gas and electric business by selling gas and electric appliances in a city of 25,000 in New York State. AS-159, Elec. World.

Canadian Representation Desired

One of the most prominent European electrical concerns wants agent or representative in Canada for introducing complete line of electrical appliances and machinery. Only well-established firms need apply. AS-186, Elec. World.

SUPER-SALESMEN

Three experienced specialty salesmen who can qualify as territorial managers for Pacific Coast and Rocky Mountain States on line of electrical heating appliances. Only those who have proven their fibre and can show a record of sales accomplishment will be considered for these openings. Acquaintance with the jobbing and dealer trade also very essential. First letter should cover all details of experience and qualifications.

AS170—Electrical World,
1570 Old Colony Bldg., Chicago, Ill.

FOR SALE

PRODUCTOGRAPH
—AT A BARGAIN

Will keep count and curve drawing sheet record on 20 producing machines. Operates on 20-v. D.C. service.

Original cost $600. First-class shape. Various spare parts included.

W. A. HEFNER
c/o McGraw-Hill Co., 10th Ave. at 36th St., New York City.

EDUCATIONAL

METERMEN: Double or treble your earning capacity through our course in electrical meter engineering. Smeltzer, of Pennsylvania, reports 100% increase in salary. Martin, Illinois, formerly substation operator, now superintendent of meters for 24 towns. Hundreds of other students report our course the best investment they ever made. Endorsed by leading electrical men. Write for free information today. Fort Wayne Correspondence School, Ft. Wayne, Ind.

U. S. GOVERNMENT

Bids: July 12.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 15, 1920.—Sealed proposals will be opened in this office at 3 p.m., July 12, 1920, for additions and repairs to conduit and wiring, new lighting fixtures and furniture lighting in the United States Post Office at Zanesville, Ohio, in accordance with the drawings and specification, copies of which may be had at this office or at the office of the Custodian, at Zanesville, Ohio, in the discretion of the Supervising Architect. JAS. A. WETMORE, Acting Supervising Architect.

Bids: July 15.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 17, 1920,—Sealed proposals will be opened in this office at 3 p.m., July 15, 1920, for removing old conduit and wiring and lighting fixtures and furnishing and installing new conduit and wiring and new lighting fixtures, etc., in the United States Courthouse and Post Office, Opelousas, La., in accordance with the specification and drawings, copies of which may be had at this office or at the office of the Custodian, Opelousas, La., in the discretion of the Supervising Architect. JAMES A. WETMORE, Acting Supervising Architect.

Bids: July 15.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 18, 1920.—Sealed proposals will be opened in this office at 3 p.m., July 15, 1920, for removing the present conduit and wiring and lighting fixtures and furnishing and installing a new conduit and wiring system and furnishing and installing new interior lighting fixtures, in the United States marine hospital at Cleveland, Ohio, in accordance with drawings and specifications, copies of which may be had at this office or at the office of the custodian, Cleveland, Ohio, in the discretion of the Supervising Architect. JAMES A. WETMORE, Acting Supervising Architect.

"ELECTRICAL HAND BOOK"

The "Burgess Blue Book" contains drawings and diagrams of Electrical Machinery and Connections—Starting Boxes, Elevators, Controllers, Starters for Printing Press Motors, Street Car Controllers, Transformer Connections, Lighting Circuits.

The section on Calculations takes up Simple Electrical Mathematics, Wiring Tables, Alternating Current Calculations, etc. It also gives 200 formulas, with problems worked out, showing their application.

Price $1.00. If you decide not to keep it, your money will be returned.

BURGESS ENGINEERING CO.
749 East 42nd St., Chicago, Ill.

LIGHT PLANT
FOR SALE

Prosperous growing Kentucky town of 900. Revenue, $7,500 year. Rate, 18c. Minimum, $1.80. Price, $8,500.

BO164—Electrical World,
1570 Old Colony Bldg., Chicago, Ill.

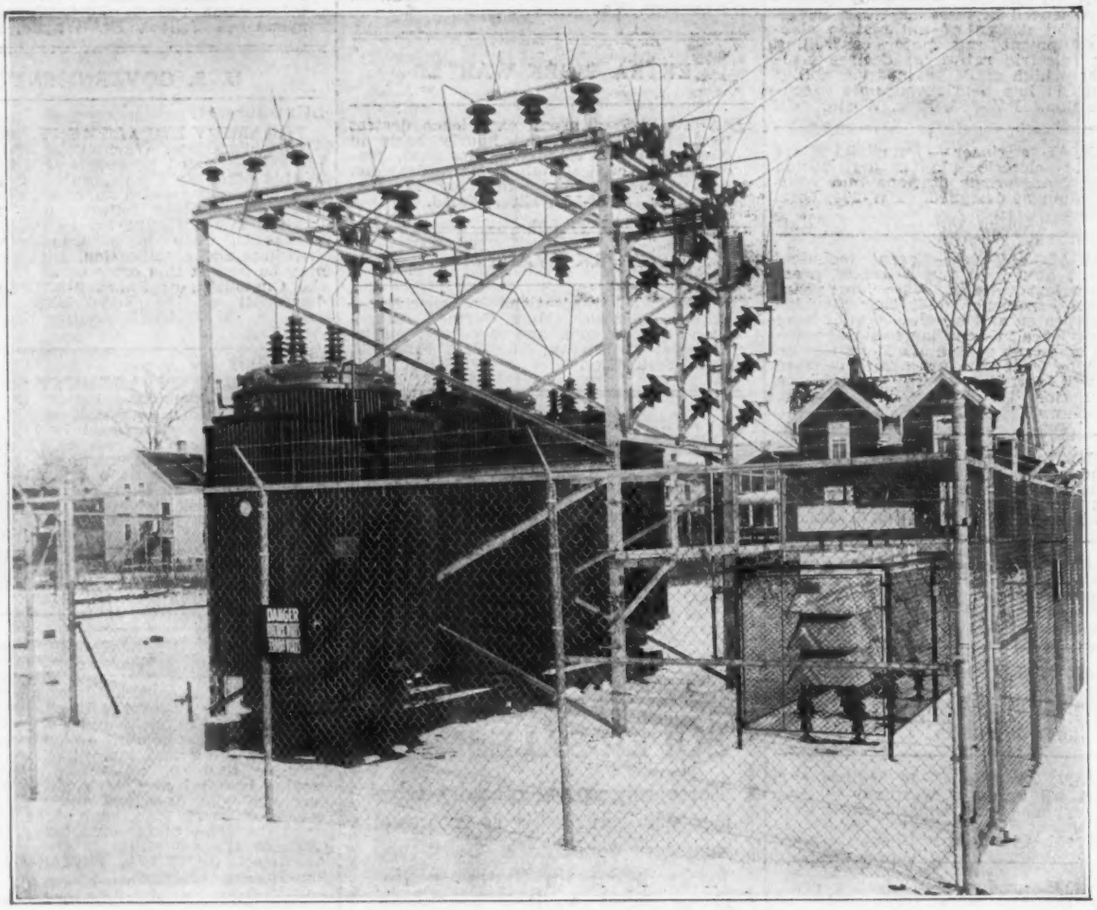
"Opportunity" Advertising:

Think
"SEARCHLIGHT"
First!

0099

HIGH TENSION EQUIPMENT

Why Should An Outdoor Substation be Homely? This one isn't— (Is it?)



5000 K.V.A. 20,000/33,000 Volt Unit Type Steel Tower Substation

There is no reason today for installing a substation which is an eyesore, one which impairs values of adjoining property, or invites public criticism. The day of construction, simply to meet load conditions, is past—you must consider public opinion.

Central station public policy of today demands that outdoor substations must present a pleasing appearance, and there are two angles to this kind of public utility policy.

(1) The public utility which can show properties and equipment that have a good engineering appearance, can more easily attract financial backing and credit.

(2) Outdoor substations of good appearance arouse community pride and public good will.

Our engineers can furnish designs and working drawings which will enable you to build outdoor substations that will be a real asset—and also insure good operation.

Do not make the mistake of deciding against Unit Type substations, because of their low cost.

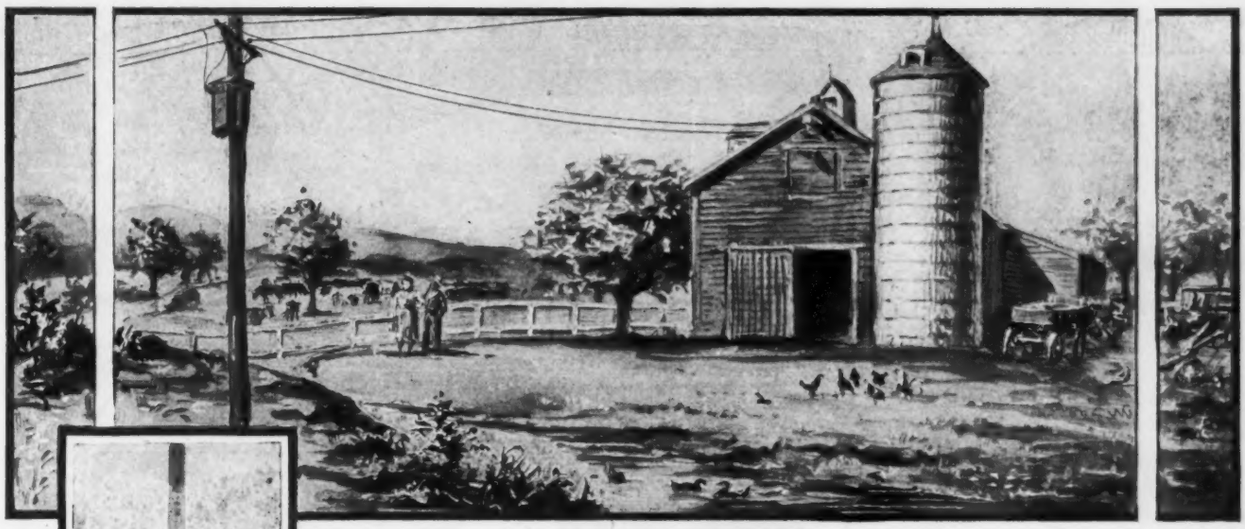
Delta-Star Electric Company

2433-53 Fulton St., Chicago, Ill.

New York, N. Y., 25 Broad St.
Boston, Mass., 76 Pearl St.
Rochester, N. Y., E. & B. Building
Syracuse, N. Y., City Bank Bldg.
Buffalo, N. Y., 601 Ellicott Square
St. Louis, Mo., Railway Exchange
Salt Lake, Utah, 59 Broadway
Toronto, Ont., 67 Yonge St.
Indianapolis, 518 Trac. Term. Bldg.
Seattle, Wash., Hoge Building
Philadelphia, Pa., 1333 Real Estate Trust
Denver, Colo., 1633 Tremont St.
Pittsburgh, Pa., Union Arcade

DELTA-STAR HIGH TENSION EQUIPMENT

UNIT-TYPE INTERCHANGEABLE PARTS



Supplying the Farm

The farmers of the country are clamoring for electric power and light.

The central stations are awake to the wide possibilities in this field and are preparing to meet them.

Engineers realize that the equipment used in rural work must be of the highest standard because it is difficult to reach and maintain. Many have turned to Kuhlman and eventually thousands of others will, because Kuhlman Transformers for farm work are of the same high quality as their city brothers. Kuhlman's are the crystallization of over 25 years' experience in building transformers—in specializing on transformers.

KUHLMAN Electric Co.

Bay City, Mich.

DISTRICT OFFICES:

Chicago, Ill.
15 N. Jefferson St.

Buffalo, N. Y.
280 Carolina St.

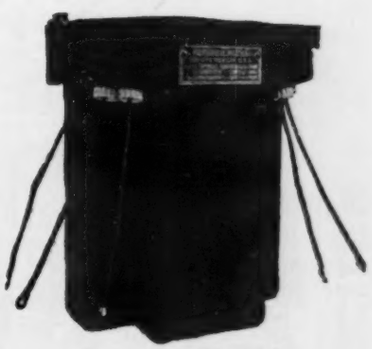
Los Angeles, Calif.
626 Washington Bldg.

Minneapolis, Minn.
21 N. 6th St.

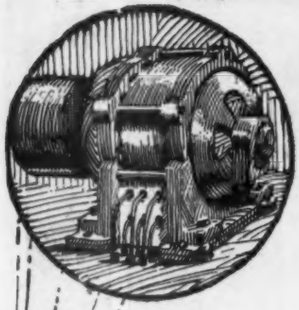
E. N. Hyde Electric Co.
1500 W. Montgomery Ave.
Philadelphia, Pa.

Toledo, Ohio
27-32 St. Clair St.

W. J. Hugo
Madison, Wis.



KUHLMAN TRANSFORMERS



Rome-Wire

The Symbol of
Efficiency in Electrical Conductors

HOT ROLLED COPPER AND BRONZE RODS

COPPER AND BRONZE BARE WIRE
Round, square and rectangluar, plain and tinned

COPPER AND BRONZE TROLLEY WIRES
Round, grooved and figure eight

POWER CABLES
Solid and Stranded

ROUND EDGE FLAT COPPER WIRE

MAGNET WIRE
Round, square and rectangular
cotton covered
silk covered
enameled covered
enamel and cotton
enamel and silk

POLISHED COPPER PIANO COVERING WIRE

RUBBER INSULATED WIRE
Bridle wires
flexible cords
jumper wires
telephone wires
N. E. C. S. wire
fixture wires
heater cords

SPECIAL WIRES AND CABLES

GATHERING LOCOMOTIVE CABLE

GAS ENGINE CABLE

MINING MACHINE CABLE

WIRES AND CABLES FOR EXPORT

DECK CABLE

BREWERY CORD

AUTOMOBILE WIRES
Charging cables, ignition wires
starter cable, lighting wire
horn wire.

ROME WIRE CO.
ROME, N.Y.
U.S.A.

All Operations from Wire Bar to Finished Product in this Plant

Why is it cheaper to use HAZARD Insulated Wire and Cable, when it costs more than "just wire"?
Quality Survives.
HAZARD MFG. CO.
New York
533 Canal St.
Chicago
552 W. Adams St.
Pittsburgh
1st Nat'l Bank Bldg.
Denver
1415 Wazee St.
Wilkes-Barre, Pa.
HAZARD MANUFACTURING CO.
WILKES-BARRE, PA.
HAZARD

HABIRSHAW

"Proven by the test of time"

Insulated Wire & Cable

Setting the Seal of Safety Upon Power Illimitable

ELECTRICITY is the pervading force of industry and civilization. Under its stimulus, methods of production and modes of living steadily and surely are changing.

It has made power a common commodity, turned on or off, as the tap-master —transmitter, as wheat or cloth. It has no limitations of time or place, serving a householder's lamp or glowing stove, the huge motors of a speeding train, turning the shafts of a distant factory, equally available at the meridians of night and day.

The modern utilization of electricity depends in important degree upon the safe harnessing of its giant force.

In this work Habirshaw has been an active and leading factor. Since the early days of the electrical industry Habirshaw research engineers have been continuously at work upon the practical problems of electrical insulation. And they have contributed much to the modern knowledge and technic of this work.

Great cables for the transmission of power of an immensity not to be compassed by unaided imagination, as well as simple code wire which networks the walls of dwellings, are now designed and manufactured with the same precision, certainty and ample factors of safety with which the steel fabric of a great skyscraper is engineered and built.

In the Habirshaw plants production engineers have applied not only the findings of the research laboratories, but also the experience and methods of modern manufacturing, maintaining an output which meets the electrical engineer's laboratory standards and anticipates the public request for moderation in cost.

Habirshaw is setting the seal of safety upon the power illimitable, and the stamp of economy also.

The economies of volume production can be supplemented only by the economies of national distribution. Habirshaw Insulated Wire and Cables are brought to every active market of the United States by the national warehousing and distributing organization of the Western Electric Company. The facilities of this great concern supplementing Habirshaw engineering and manufacturing renders to the public a comprehensive service of production and delivery to the point of use.

Western Electric materials and equipment throughout safeguard electrical service, for all are standard as Habirshaw. Final assurance is gained by entrusting installations only to your architect or qualified electrical engineers or contractors.

Habirshaw Wire Manufactured by Habirshaw Electric Cable Co. Incorporated 10 East 43rd Street, New York

Habirshaw Wire Distributed by Western Electric Company Incorporated Offices in All Principal Cities

HABIRSHAW
"Proven by the test of time"
Insulated Wire & Cable
Plus Western Electric Company's Service

This is one of a series of advertisements appearing in Saturday Evening Post, Literary Digest and other national magazines.

HABIRSHAW in all of its national advertising intends to stimulate public interest in all things electrical. This broad, co-operative policy helps the entire industry—architects, engineers, contractors, dealers, etc.—as well as Habirshaw.

The advertisement reproduced above is an example of this method of giving publicity to Habirshaw quality and at the same time building public confidence in the industry.

Habirshaw products are brought to every active market of the United States by the national warehousing and distributing organization of the Western Electric Company. The sign of service and the seal of safety are united.

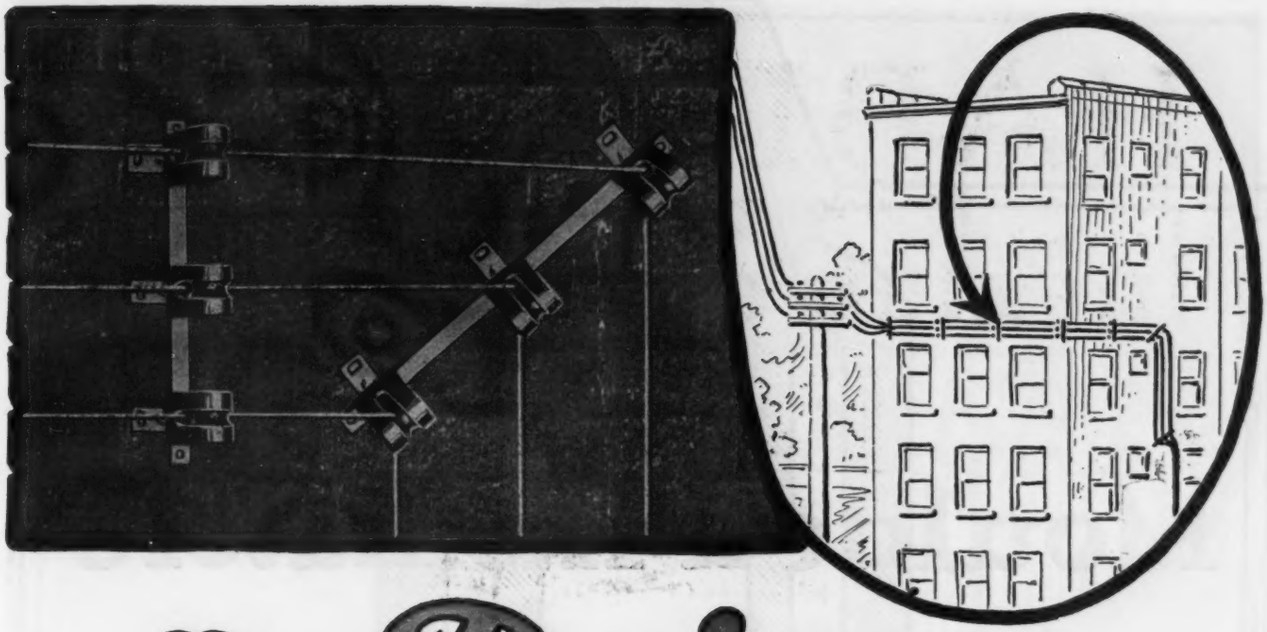
Habirshaw Wire Manufactured by
Habirshaw Electric Cable Co.
Incorporated
10 East 43rd Street, New York

Habirshaw Wire Distributed by
Western Electric Company
Incorporated
Offices in All Principal Cities

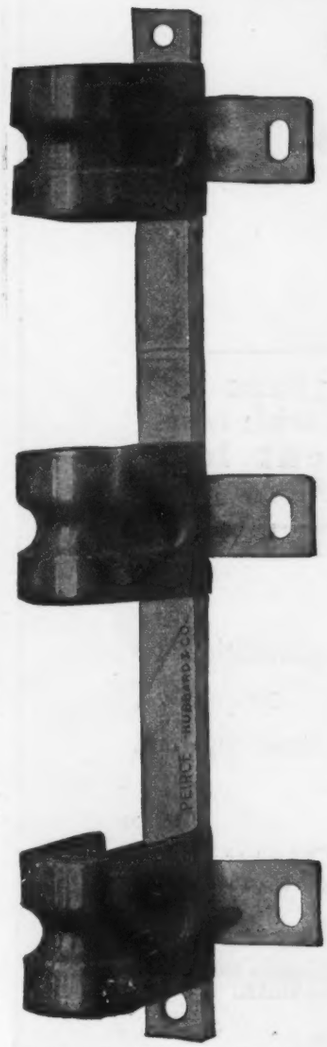
Paper Insulated Cable
Round Conductor Cables
Sector Cables

Varnished Cambric Insulated Cables
Armored Cables

Rubber Insulated Cables
Code (Black Core)
Intermediate (Red Core)
30% Hevea R. S. A. Standard



The Peirce WIREHOLDER



Why do we call it a "Wireholder?"

Because it will hold your wires—just as it comes to you without any extras.

When you use house brackets, you must buy insulators and tie wires to use with them.

But the **Peirce Wireholder** *is a complete article.*

It comes with insulators assembled on it, and the insulators are designed to eliminate tie wires. The line wires are merely threaded through the holes.

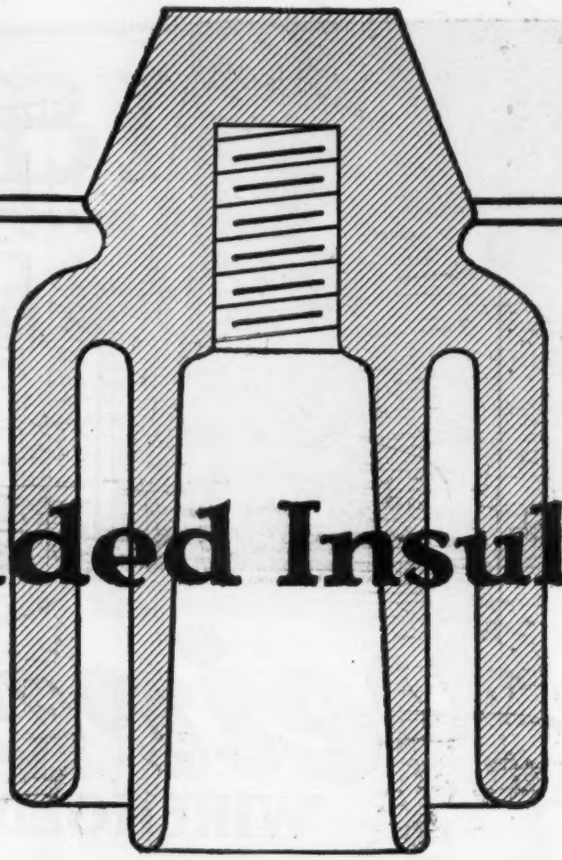
The complete wireholder costs you about the same as the incomplete bracket.

You save the cost of

3 D. G. D. P. insulators	$ .17
3 Tie Wires	.13
Labor of assembling	.01
Labor of tying in	.02
	$ .33

and you get a more dependable job and a neater one. See your Jobber. He carries the **Wireholder** in six styles.

HUBBARD & COMPANY
PITTSBURGH, PA.



Moulded Insulators

"TELENDURON"

The Points that Count:

Average insulation; 500,000 megohms at 500 volts, D.C.	Unaffected by acids, or variation in temperature.	No glaze to crack with consequent low insulation.

UNBREAKABLE

THESE Insulators have been supplied in large quantities to the General Post Office, and leading Railway Companies. National physical laboratory reports confirm our test figures.

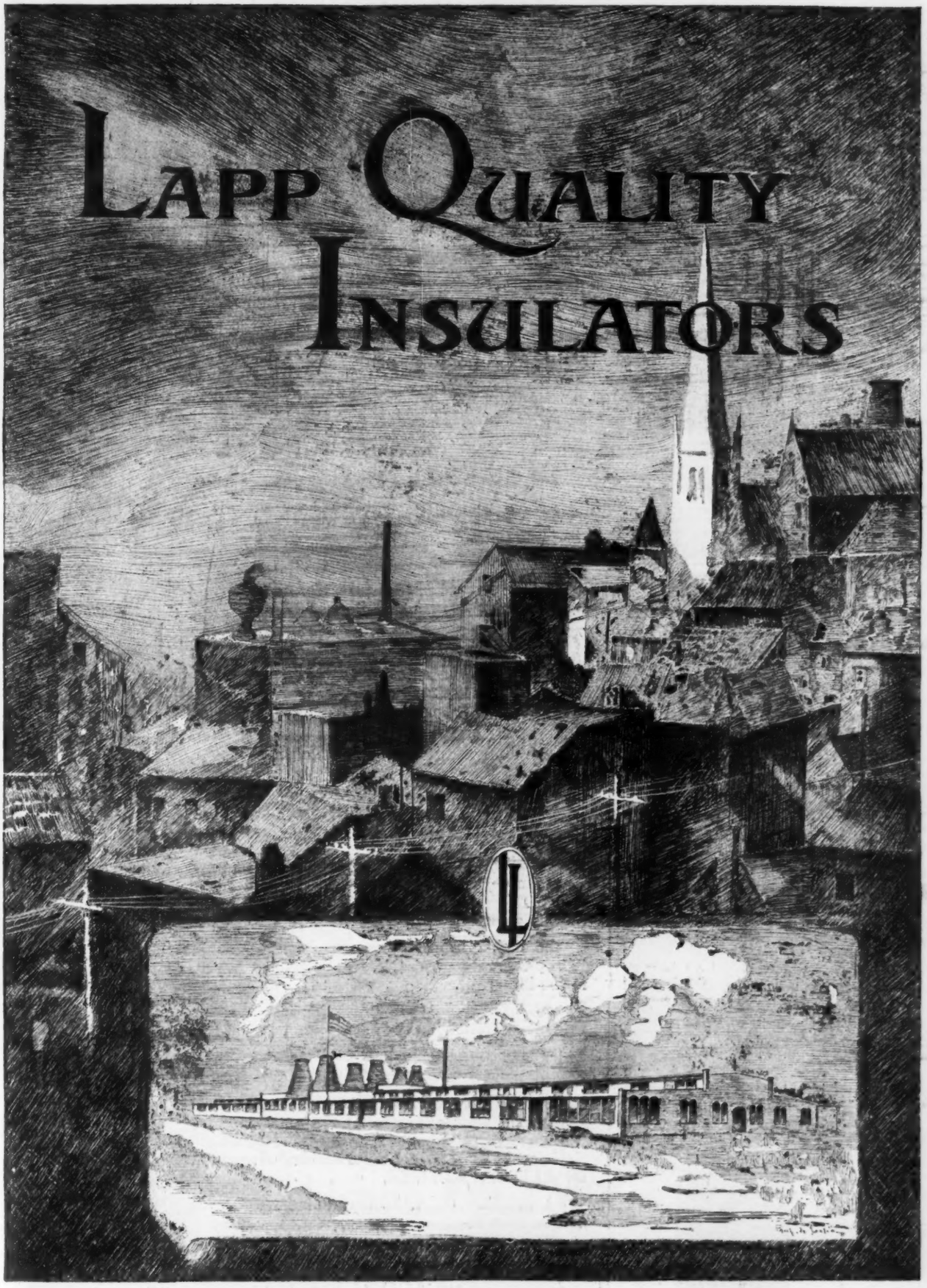
IF YOU ARE INTERESTED WRITE FOR BROCHURE No. 10

THOMAS DE LA RUE & CO., LTD.

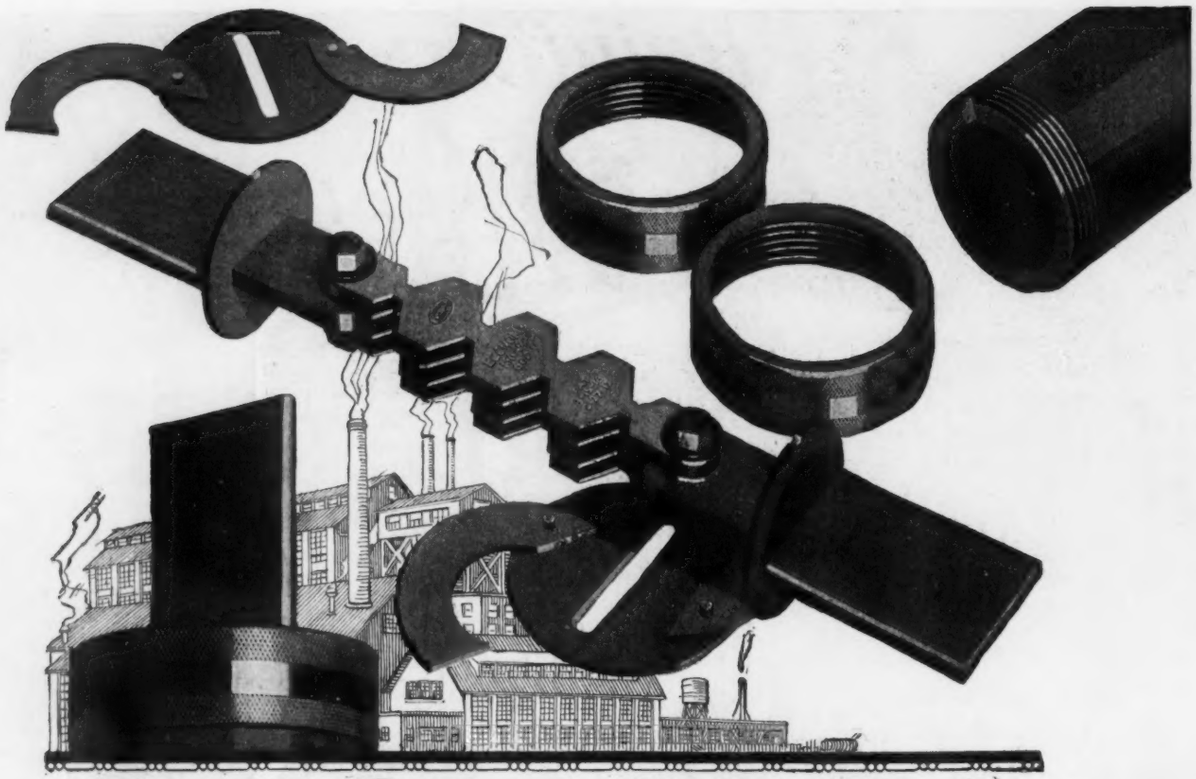
Manufacturers of Composition Mouldings for Electrical Insulation Purposes

For Europe, Canada and Colonies address LONDON
Shern-Hall St., Walthamstow, E. 17

For South America and United States address NEW YORK
Aeolian Bldg., 29-33 West 42nd St.



Lapp Insulator Co., Inc., Le Roy, N. Y., is mailing new Catalog No. 2. Be sure to get your copy.



ECONOMY *renewable* FUSES

have for years cut 80% out of the annual fuse maintenance costs of all industries using electrical energy.

The simple, accurately rated, inexpensive Economy "Drop-Out" Renewal Link is easily and quickly replaced when a fuse is blown.

In the higher capacity fuses, multiple Economy "Drop-Out" Renewal Links are used, as shown in the illustration.

The Winged Washer adds to the ease and convenience of renewing the fuse.

Extra heavy brass end caps, knurled and threaded, complete the fuse assembly.

ECONOMY renewable FUSE was the first fuse using an inexpensive bare renewal link for restoring a blown fuse to its original efficiency to gain full Underwriters' Approval IN ALL CAPACITIES.

Buy Economy Fuses and Economy "Drop Out" Renewal Links from leading electrical jobbers and dealers

ECONOMY FUSE & MFG. CO.
CHICAGO, U. S. A.

Economy Fuses are also made in Canada at Montreal

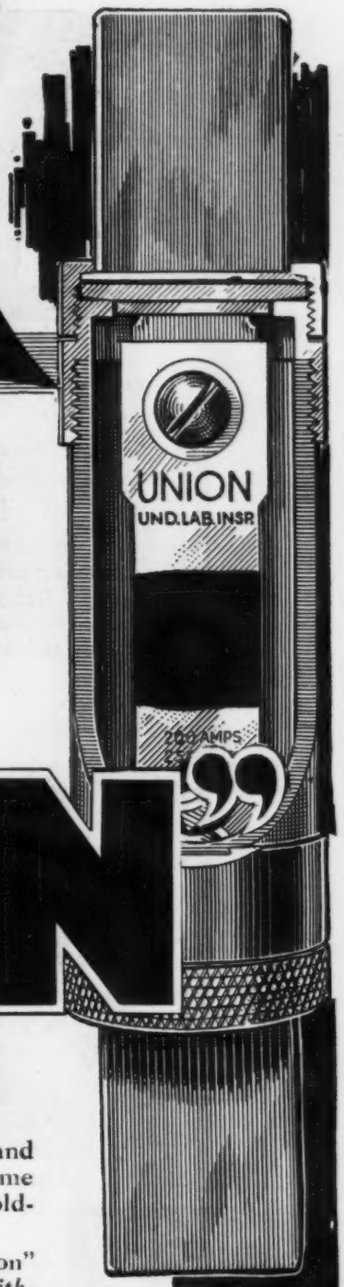
Insist on these marks of official approval:

UND. LAB. INSPECTED

The symbol on the link

The label on the fuse

Reinforced Like a Shotgun Shell



You would consider it ridiculous if the metal cap were placed *inside* the paper shell casing of a shotgun shell—leaving the casing alone to withstand the tremendous pressure to which it is subjected.

Yet—in many renewable fuses, the metal cap screws *inside* the casing, leaving the weakest points of the tube to withstand, as best they can, the pressure of gases when the fuse blows. This is one of the reasons why the average renewable fuse cannot withstand many heavy blowouts before the casing is rendered unfit for further service.

It's different with the

"UNION"

RENEWABLE FUSE

Heavy brass ferrules (onto which the caps screw) are riveted and screwed onto the *outside* of the tough fibre casing, serving the same purpose as the cap in the shotgun shell—reinforcing the tube and holding it firm against the pressure of the gases inside.

This is just one of the construction points in which the "Union" Renewable Fuse excels—just one of the points that enable it to *withstand more blowouts than any other Renewable Fuse.*

Every part of the "Union" Renewable Fuse is mechanically correct. Every part is heavy enough and strong enough to insure effective, *lasting* service.

Don't waste time and money on Renewable Fuses that will only stand a few blowouts. Use the fuse that can be renewed *indefinitely*, because of its superior construction—the "Union" Renewable Fuse.

"Union" Fuses are sold by electrical dealers everywhere in the two types, Renewable and Non-Renewable.

UNION
TRADE MARK.

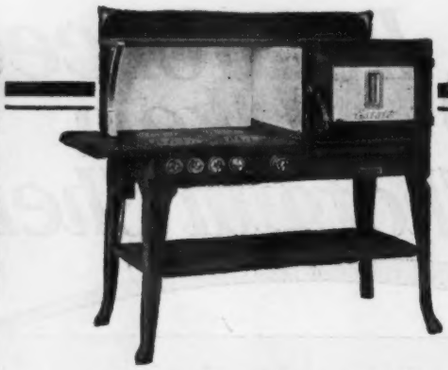
Chicago Fuse Mfg. Co.

Oldest and largest manufacturers of Fuses, Electrical Protecting Materials and Conduit Fittings

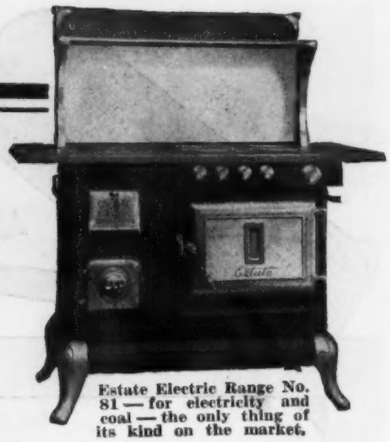
Chicago **New York**

Boston, Cleveland, Los Angeles, Detroit, Kansas City, Pittsburgh, Philadelphia, St. Louis, San Francisco, Seattle, Minneapolis, Indianapolis, Birmingham, Grand Rapids, Milwaukee.

Estate Electric Range No. 84.



Estate Electric Range No. 88. Similar to No. 84, but oven and broiler combined.



Estate Electric Range No. 81 — for electricity and coal — the only thing of its kind on the market.

Simple, Not Spectacular!

You want your share of the profits which are being made on the sale of Electric Ranges. But you want to select the right range—the one which will be most satisfactory to handle.

There is only one way to decide. Investigate the different Electric Ranges. Compare their construction, their simplicity. Find out which will necessitate fewest calls for "service" on your part. We believe you will decide on the Estate.

Estate
ELECTRIC RANGES

The Estate Quick-Detachable Surface and Oven Units are a most important feature. They can be lifted out and replaced by the user without tools. Any part of the wiring system is instantly accessible. This means much to you as well as to the user.

4 Exclusive Estate Features

Quick-Detachable Surface and Oven Units of Estate Iron-Clad Construction.
All-Cast-Iron Cooking Top.
Mercury Thermometer in Oven Door.
Estate Copyrighted Cooking Chart.

The Estate cast iron cooking top will never warp and is easy to keep clean. The enclosed iron-clad surface units afford complete protection to the heater unit and provide a perfectly smooth surface for the cooking utensils.

And with the five models of Estate Electrics, you need never lose a sale. Write today for full information.

Estate Sunburst

This portable ornamental electric heater costs no more to operate than the average electric iron. Every home and every office which is wired for electricity is a prospect. Write for description and prices.

The Estate Stove Company

Manufacturers of High-Grade Stoves and Ranges Since 1845

Hamilton, Ohio

Estate Electric Range No. 82. A compact, elevated oven type.

Estate Electric Distributors

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Estate Electric Range No. 83. Ideal for the average family.

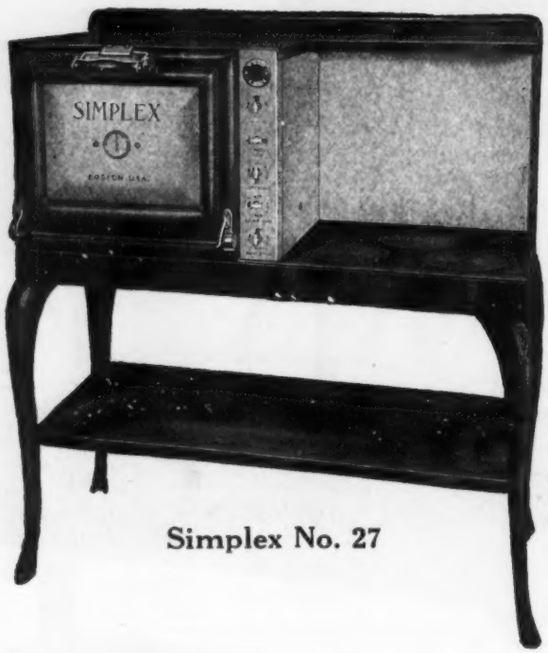
What is behind the
Hughes Electric Range?

This is only a suggestion of the methods we are using in helping the Central Station man put over the Hughes Electric. The advertisements reproduced here show the general type of Hughes advertising that is appearing this year in the Saturday Evening Post, the Ladies' Home Journal and Good Housekeeping.

If you are not getting your share of the business being developed by this advertising let us go over the Range situation with you. Write the Range Department at our Chicago office.

EDISON ELECTRIC APPLIANCE CO., INC.
Chicago
New York Ontario California Atlanta

THE BEST SELLING ELECTRIC RANGE TODAY



Simplex No. 27

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Connecticut, Waterbury	The New England Eng. Co.
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Georgia, Atlanta	Southern Elec. Supply Co.
Illinois, Chicago	Central Elec. Co.
Illinois, Chicago	Electric Appliance Co.
Indiana, Fort Wayne	National Mill Supply Co.
Kansas, Wichita	United Elec. Co.
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Massachusetts, Boston	United Elec. Supply Co.
Michigan, Detroit	Electrical Warehouse
Michigan, Lansing	Capitol Elec. Supply Co.
Minnesota, Duluth	Marshall-Wells Co.
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North Carolina, Charlotte	Carolina States Elec. Co.
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Ohio, Columbus	Avery-Loeb Elec. Co.
Oklahoma, Oklahoma City	United Elec. Co.
Pennsylvania, Philadelphia	The Philadelphia Elec. Co., Supply Dept.
Pennsylvania, Pittsburgh	Electric Appliance Co.
Rhode Island, Providence	Boss Elec'l Supply Co.
Tennessee, Memphis	Electric Supply Co.
Texas, Dallas	Electric Appliance Co.
Texas, Dallas	Huey & Philp Hdwe. Co.
Texas, Houston	Barden Elec. & Mach. Co.
Utah, Salt Lake City	Inter-Mountain Elec. Co.
Virginia, Norfolk	Woodhouse Elec. Co.
Canada, Winnipeg	J. B. Lawrence & Co.

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Australia	American Trading Co.
Brazil, Rio de Janeiro	C. A. Pope
Cuba, Havana	Jos. E. Mustelier
France, Paris	Levy Simon
Holland, Amsterdam	Schroeder & Van Santen
New Zealand, Christ Chuch	India Rubber, G. P. & T. Wks., Ltd. Co.
Norway, Christiania	Holterman & Osterbye
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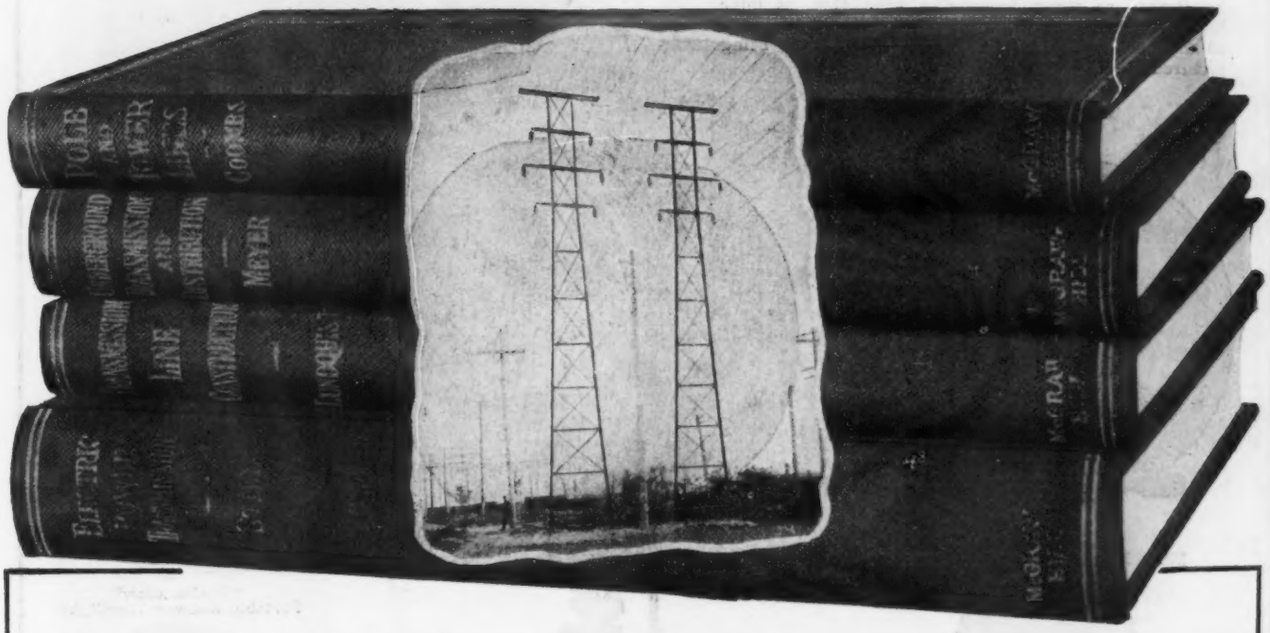

Today information counts. You and every other electrical engineer face many problems. How to cut costs, how to promote efficient distribution, how to utilize the latest improvements in overhead and underground transmission—these are points of pressing importance. Other men have solved some of your problems and their experience is open to you in the pages of the LIBRARY OF POWER TRANSMISSION.

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"Golden Glow" Products

are all equipped with the "Golden Glow" reflector which is a ground and polished glass mirror reflector that will never tarnish or corrode and is easily wiped clean with a rag without danger of scratching the reflecting surface.

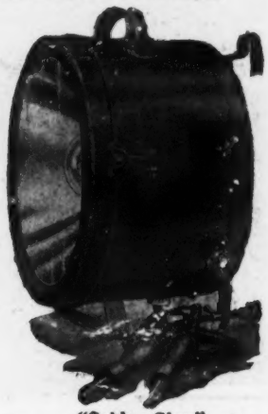
They are housed in dust and weatherproof cases for several classes of service—as electric railway headlights, as steam locomotive headlights, as mine locomotive headlights, as floodlighting projectors and as marine searchlights, a typical type of each being pictured.

Write for Data.

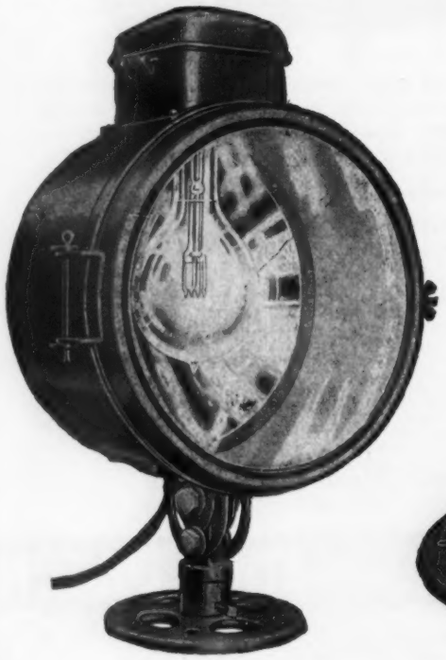
"Golden Glow"
Steam Locomotive Headlight

"Golden Glow"
Mine Locomotive Headlight

"Golden Glow"
Portable Floodlighting Projector



"Golden Glow"
Portable Railway Headlight



"Golden Glow"
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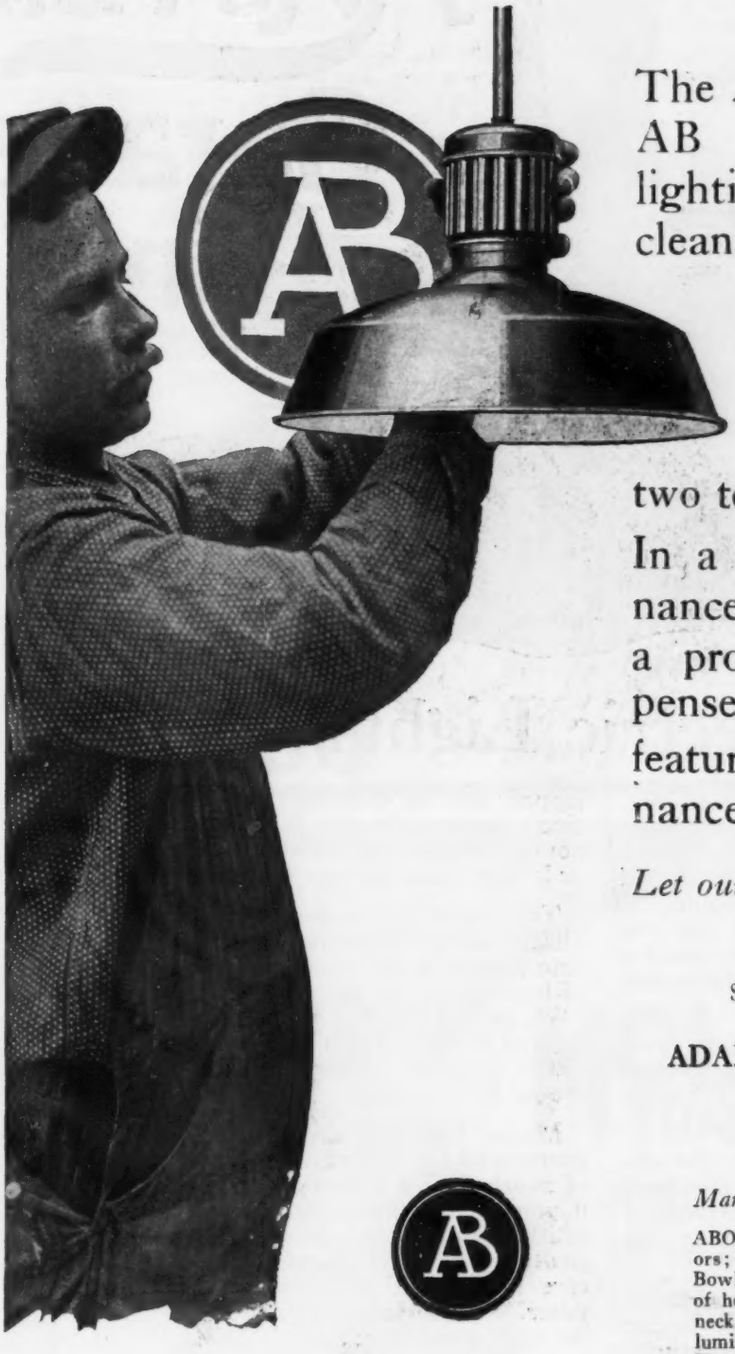
"Golden Glow"
Marine Searchlight

ELECTRIC SERVICE SUPPLIES CO.

Manufacturer of Railway Material and Electrical Supplies

PHILADELPHIA	PITTSBURGH	NEW YORK	CHICAGO
17th and Cambria Streets	337 Oliver Building	50 Church Street	Monadnock Building

Maintenance Features of ABolites



The ABolite reflector with the AB holder socket makes a lighting unit which is easy to clean. The shade is detached from the holder socket by merely compressing the copper-clad steel spring which holds the two together.

In a large plant the maintenance of the lighting system is a problem as well as an expense. This exclusive ABolite feature reduces the maintenance cost to a minimum.

Let our representative give you further details.

SMALL MOTORS—GYROFANS

ADAMS-BAGNALL ELECTRIC CO.
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Manufacturers of

ABOLITE REFLECTORS—Four types of reflectors; RLM, Shallow Dome, Deep Bowl and Angle Bowl—furnished interchangeable with three types of holders and three additional types of one-piece neck construction—for Industrial Plants, Sign Illumination, Show Windows, Roadways, Sidewalks, Yardways, Garages, etc.

ADAMS-BAGNALL

MASTER Garage Pump

"As Handy As Electric Lights!"

THAT'S what the garage men say. The Master Garage Pump has proven itself finally and completely as necessary garage equipment. Large numbers of electrical contractors who are equipping public and private garages say the Master Garage Pump is just as much a part of their installation as the lights and switches.

You don't need anything but the ordinary electric current for the Master Garage Pump. You get full pressure immediately and *there is no tank.*

The simplicity of this pump—the absolute service of the specially designed General Electric motor when it is plugged into an ordinary electric circuit—has made a big appeal to the trade.

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Master Garage Pumps are absolutely guaranteed for one year, by a company of nearly half a century's standing, and if you do not find your pump entirely satisfactory after ten days' trial, we will gladly return your money. With ordinary care and usage they should last ten years. Put a Master Garage Pump into the next garage you equip.

Send for our agents' proposition and get started at once on this fast-selling line.

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All our products are made in our own plant by modern labor saving machinery under the supervision of wire manufacturing specialists.

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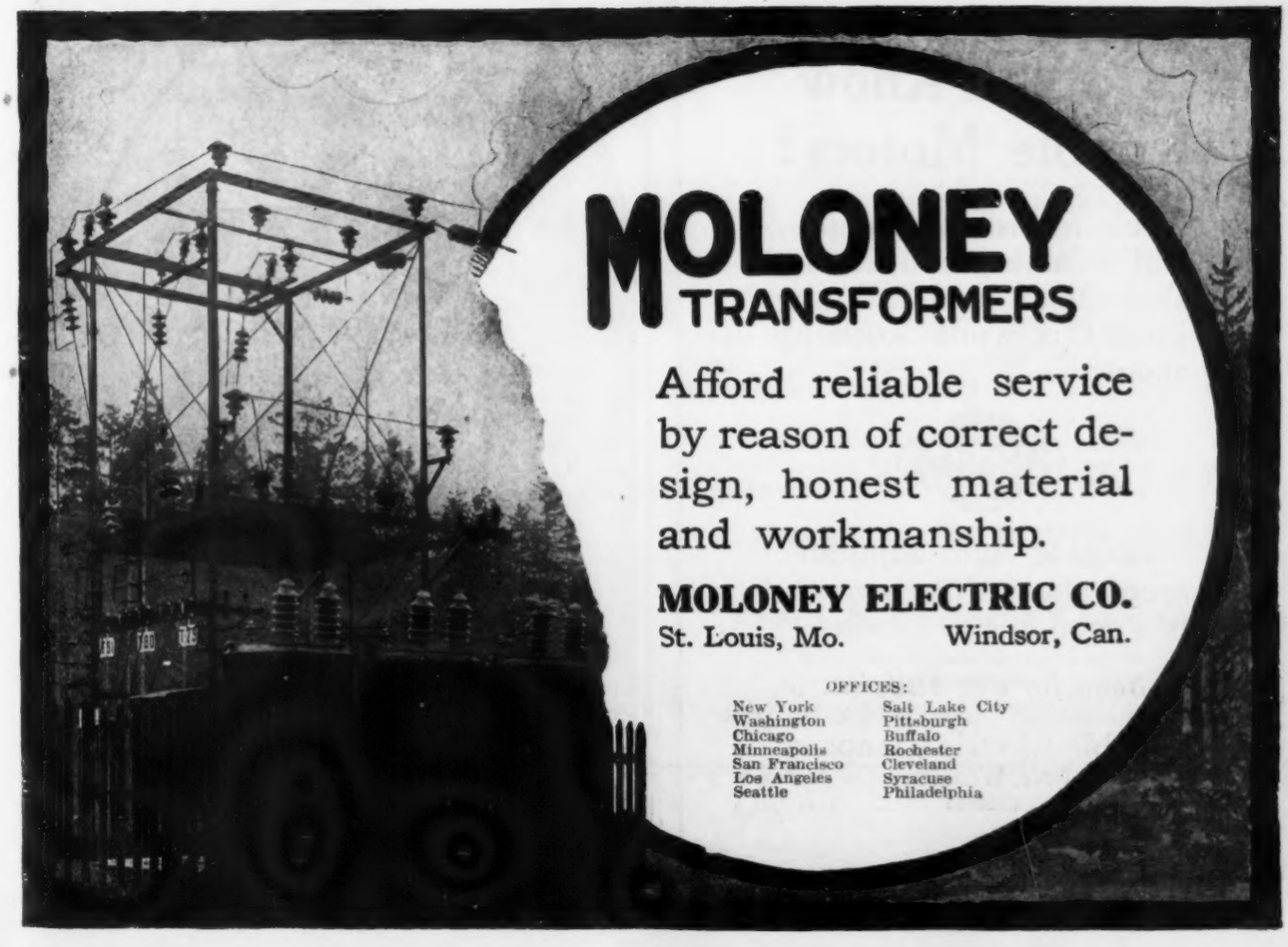
Chicago Insulated Wire & Mfg. Co.
Sycamore, Illinois

since 1885

manufacturers of a quality line of bare and insulated wires



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Afford reliable service by reason of correct design, honest material and workmanship.

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House, Hotel, Hospital, Elevator, Marine.
Wood or metal. All styles of drops and resets.

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Their record for economy and reliability in operating shop tools and printing presses is worth knowing about.

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—variable and adjustable speed, alternating current—is a good line to handle.

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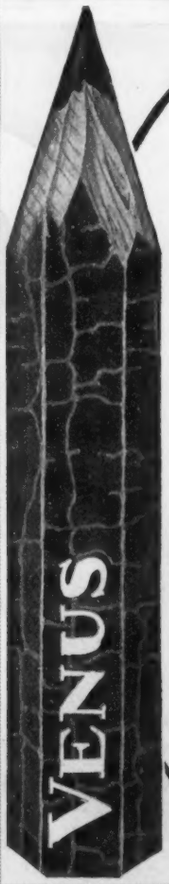

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THOSE who harness the electric force must work with *tools dependable*. Electrical engineers can depend upon the grading of the famous VENUS Pencils being *always exactly uniform.*

17 black degrees, 3 copying
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Model M2

magnets and magnets, but there is only one when it comes to selecting THE magnet as is found in the Duncan Model M2 A.C. watthour meter. No concern puts its magnets through more trying tests to establish permanency than does the Duncan Company. The processes, which include the heating, forming, machining, tempering, japanning and aging would make a good sized book if all the details were written out.

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L. & N. Copper-Constantan Thermocouple Indicators and Recorders —Potentiometer System, no errors from lead resistance—are valuable instruments either for investigational or routine tests. They give you accurate information on temperatures existing in Generators, Cables, Cable Ducts and Transformers.

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Guaranteed Accuracy, 1° C.

The cold junction temperatures are automatically compensated at the instrument. With the Recorder an alarm can be arranged to operate at the "danger" temperature.

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Put the same efficiency into your soldering methods that big electrical manufacturers use. Take a tip from these men who use tons of solder a year. They have done away with bothersome, wasteful pots of flux. They have done away with one operation in soldering—that of applying the flux separately. They use—

Kester Rosin-Core Wire Solder

It carries its own flux in a core of pockets and releases it on the job as solder is melted. Every job gets proper fluxing. No waste—no bother. Saves time, flux, and solder.

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Fill out and mail the coupon to us today. See for yourself the saving in time and material it will give you. When you find Kester Rosin-Core Solder as economical of time and material as thousands of others have, you can get it from your supply house in cartons containing one pound coils and on one, five, and ten pound spools.

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A universal electrical material

In the electrical field Diamond Fibre is the most adaptable material known. Its utility is practically without limit. It is superior for special parts of every description. Each day it replaces other materials and finds new uses.

It is a superior material for refillable fuses, bushings, cleats, conduits, wire manifolds, commutator rings, switch bars, handles, washers, gaskets, parts for dynamos and generators, etc.

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Electrical parts made from Diamond Fibre are practically indestructible. This material is tougher than horn, almost as hard as iron, yet lighter than aluminum—impervious to oil and grease and unaffected by ordinary organic solvents — does not splinter, split, crack, break, or crystallize under severe vibration or subjection to heat—non-corrodible—tensile strength 12,000-15,000 lbs. per sq. in.; compression strength 30,000-40,000 lbs. per sq. in.; actually improves with age.

We also manufacture Condensite Celoron, a new waterproof material of remarkable properties, which is especially suitable for certain electrical uses where waterproofness is essential.

It will pay you to investigate the possibilities of Diamond Fibre and Condensite Celoron for your own special needs. Tell us your problem and let us co-operate. Samples and complete information on request.

Diamond State Fibre Company

Dept. A B

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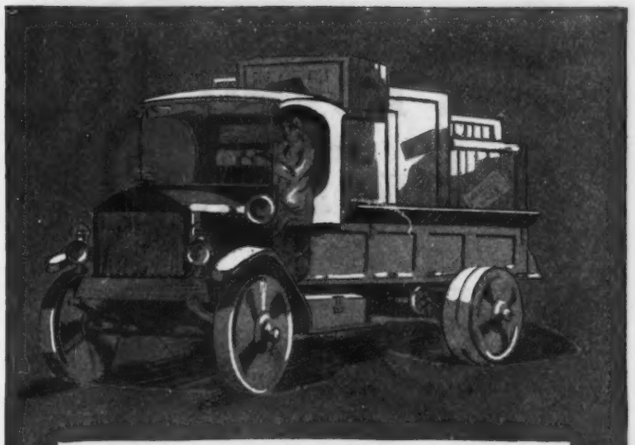

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The fact that it is unaffected by oil or grease, makes *VUL-COT* Fibre a serviceable material for use as cylinder gaskets, crank case gaskets and smaller parts.

For facings of friction clutches and for brake bands *VUL-COT* Fibre meets every condition of reasonable use.

VUL-COT Fibre

(A higher development of cotton vulcanized fibre)

Because of the ease with which it can be turned, tapped and threaded, and the smooth, even finish which it takes, it is well suited for the making of handles, cranks, etc.

Besides the parts named there are hundreds of others that are made or can be made of *VUL-COT* Fibre.

Truck and automobile manufacturers will be interested in our booklet on the electrical and mechanical uses of *VUL-COT* Fibre. Send for it.

VUL-COT Fibre is sold in sheets, rods and tubes, or machines to your specifications.

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It Saves Time, Worry, Energy

You are called to repair a motor or generator. The trouble is there, but how to find and fix it is up to you. That's when you need this new and accurate guide on

Armature Winding
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By D. H. BRAYMER

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Try these helpful kinks on the job

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ROLLER SMITH

Apparatus
for
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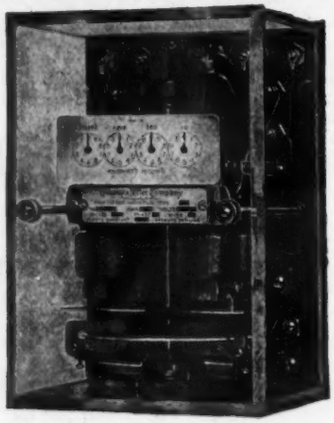

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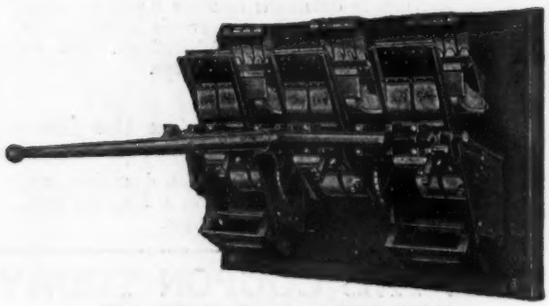

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is always the result

ROLLER-SMITH COMPANY
Electrical Instruments, Meters and Circuit Breakers

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Monadnock Block

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BALTIMORE, Builders' Exchange
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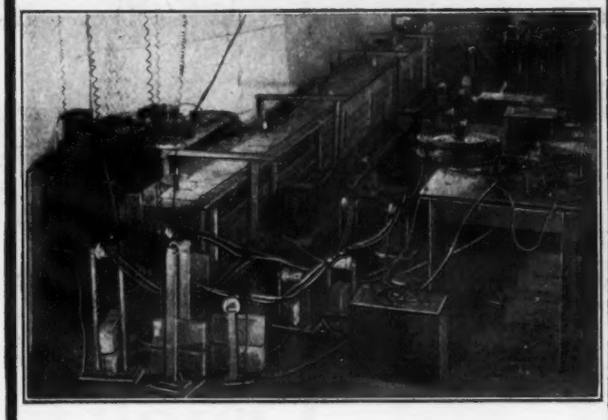
BOSTON, 141 Milk St.
BUFFALO, 716 Ellicott St.
DALLAS, 211 N. St. Paul St.
LOS ANGELES, Title Insurance Bldg.
MINNEAPOLIS, 414 South 6th S.
MONTREAL, 420 Power Bldg.
PHILADELPHIA, 63 Drexel Bldg.
PITTSBURGH, Union Arcade Bldg.
ST. LOUIS, Railway Exchange Bldg.
ST. PAUL, Pioneer Bldg.
SAN FRANCISCO, 589 Howard St.
TORONTO, 183 George St.
SEATTLE, 524 First Ave., South.

Proven By Test



Heat losses in ducts have been definitely established. The illustration shows a recent test which is only one of many made possible thru

Our Testing Facilities

The commercial value of test certificates on apparatus and equipment of all kinds is well recognized as a decisive factor in purchasing and our facilities for testing, not only in the electrical but in the mechanical, mineral and chemical fields may mean much to *your* product.

It's to your advantage to show certified proof of the quality of your product and we hold the key to the situation.

Our Bulletins contain valuable information on tests. May we send you copies?

Electrical Testing Laboratories
80th St. and East End Ave.
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Oshkosh Construction Tools

The Choice of Big Buyers

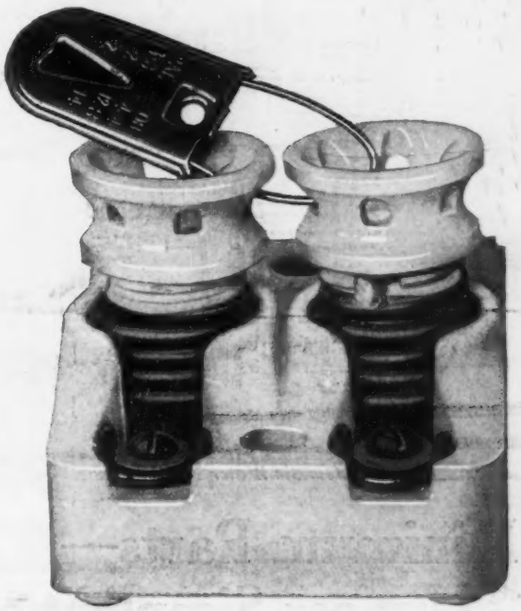
Purchasing agents and plant superintendents of telephone and telegraph companies, and large contracting and logging firms the country over, have bought Oshkosh Construction Tools for forty years.

Records show that over a period of years Oshkosh Tools give the most efficient service at the lowest cost.

Records also reveal that Oshkosh-equipped workmen accomplish more each day because they use the tools they prefer and rely upon.

OSHKOSH MFG. CO.
812 Wood St., Oshkosh, Wisconsin

METROPOLITAN SEALABLE FUSE PLUGS



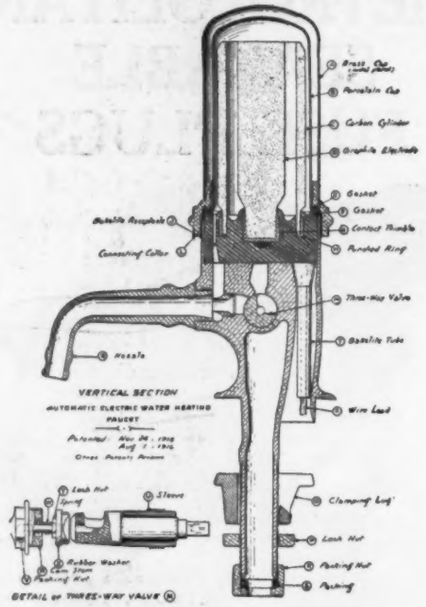
Prevent unauthorized removal of fuses from cutouts. Just the thing for central stations to use on flat rate, cut off or limited demand consumers. Capacities, 5 to 30 amps. Blanks or solid straps.

Let us send you full particulars

Metropolitan Electrical Products Company
1250 Atlantic Avenue, Brooklyn, N. Y.

Canadian Representative:
Metropolitan Engineering Co., Ltd.
90 Shelbourne St.
Toronto, Canada

METROPOLITAN ELECTRICAL PRODUCTS CO., 1250 Atlantic Ave., B'klyn, N. Y.
Gentlemen: Please send me on 30 days' approval for trial two .....Ampere {Dummy / Solid Strap} Plug.....
It is understood that this incurs no obligation on my part.
Name of Company..... Title.....
By.....
Address.....
Date.....



Sectional View of "Hotwat" Automatic Water Heating Faucet

Minimum Parts— Utmost Simplicity

The extreme simplicity of "Hotwat" Electric Water Heaters is one feature that alone makes them superior to any other electric water heating device ever before placed upon the market.

There are few parts. The heating elements consist of a carbon cylinder and graphite rod. These will last indefinitely, yet if necessary to replace them for any reason, they are exceptionally inexpensive.

Automatic Faucet and Tank Types

"Hotwat" Heaters are manufactured in two distinct types—the "Hotwat" Automatic Electric Water Heating Faucet, which heats water instantly in the faucet as needed, and the "Hotwat" Tank Heaters, for use in connection with circulating Tank system. In both types the heating elements and principle of operation are exactly the same.

"Hotwat" Heaters are efficient, reliable in operation, entirely free from troublesome features, and are the acme of convenience in the modern home, office, factory, shop, or anywhere that hot water is needed for any purpose.

Send for complete descriptive matter and our plan of co-operating with the Central Station in the marketing of these appliances.

Hotwat Distributing Company

General Sales Offices: Title Insurance Bldg.,
Los Angeles, California, U. S. A.

Siemon Sockets are Seamless

And every Siemon Socket puts a profit in your pocket. They are weatherproof seamless sockets that defy the hard usage and abuse that put the ordinary socket in the discard.

They shed the rain and stand the strain of roughest outdoor service. The lamp base is accurately positioned and firmly molded in the jacket. They have a solid porcelain center and solid brass contact. The wires are held in a water-tight grip of the one-piece seamless jacket.

Seams and weakness are left out and strength is put in by molding them in one seamless piece.

Siemon Solid Bushings

have solid, continuous threads. They have no cross seams to work at cross purposes. They catch the socket thread at the beginning—follow it smoothly and snugly to the end. Avoid bushing breakage by using the Siemon Seamless Line.

Siemon Hard Rubber Corporation

BRIDGEPORT CONNECTICUT

LOCKE INSULATOR MFG. CO.
VICTOR, N. Y.

Steel Poles
For Every Pole Purpose

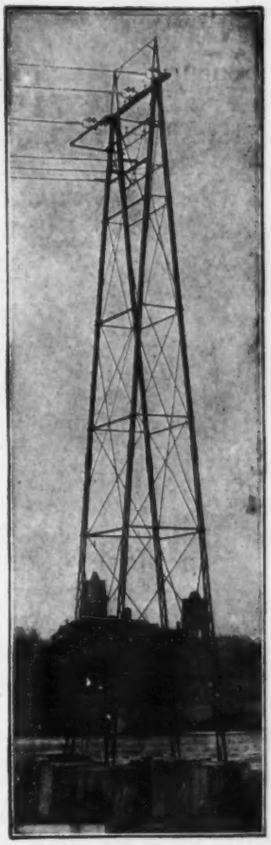
Cut shows Bates Steel Towers in use by Consolidated Water Power & Paper Co., Grand Rapids, Wis. This structure is 70 ft. high and acts as dead end for six heavy conductors on 1000 ft. span. It evidences the broad range of adaptability of Bates Steel Poles. Our slogan "STEEL POLES FOR EVERY POLE PURPOSE" is most fitting and appropriate. Bates Steel Poles are becoming universally popular world wide. Repeat orders testify their general suitability for every Pole purpose.

Telegraph
Telephone
Power Transmission
Electric Trolley Lines
Electric Lighting, Etc.

Highest class and most up-to-date steel pole equipment in the world. Our STEEL POLE TREATISE tells the story. Ask for it.

About 2,000 tons of steel constantly on hand; immediate shipments and lowest prices.

Tubular Steel Poles cost 50% more than Bates Steel Poles, yet Bates Poles are 100% stronger—will last 100% longer, cover a much broader range of adaptability and are much more artistic than Tubular Poles. Ask us to verify these facts.



Bates Expanded Steel Truss Company
208 So. La Salle St.
Chicago, Ill., U. S. A.

INTER-COMMUNICATING TELEPHONES

12-Station Wall Telephone

REMEMBER—it is the "insides" of a telephone that causes good or bad service and the exterior lines and finish that look attractive. Both ideals are successfully combined in Stromberg-Carlson apparatus.

We furnish an improved system for business and residence uses in which the pressure of one button once calls and connects the desired distant telephone. No dials—no operator—day and night service.

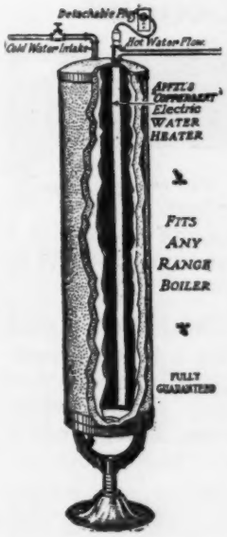
Write for Bulletin No. 1017 and Booklet "Why Walk?"

Dealers and Installers in Principal Cities

Stromberg-Carlson Tel. Mfg. Co.
Rochester, N. Y.

Chicago, Ill. *Kansas City, Mo.* *Toronto, Ont.*

"COPPERSERT"



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An Electric Water Heater that is 100% Efficient

This is a time tested heating device, in fact it has been on the market for the last nine years and it is known in every country. There is absolutely no heat lost in the process of heating because the element is always surrounded by the water.

It will fit any standard range boiler and no changing of pipes or extra fittings are required to install it.

Price is $25.00 f.o.b. Seattle, and when packed for shipment weight is 10 lbs.

ELECTRIC HEATING & MFG. CO.
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When it is desired to use an enameled wire of high quality, such as our BELDENAMEL, in the larger sizes where there must be protection against mechanical abrasion, or where impregnation is necessary, our

Cotenamel
TRADE MARK.

Magnet Wire, which consists of BELDENAMEL with one or two servings of the best quality of Sea Island cotton, is used.

COTENAMEL possesses all the good points of the ordinary cotton covered magnet wire, combined with those qualities of BELDENAMEL which have made it so useful in the electrical industry.

Belden Manufacturing Company
Twenty-third Street and Western Avenue
CHICAGO
Eastern Office and Warehouse—Metuchen, New Jersey

Charles W. Baker, President Clarence B. Mitchell, Vice-Pres.

Manganin
Sheet and Wire

We have been manufacturing this alloy with satisfaction for more than one year and can supply it in all shapes and sizes from large sheets down to very fine wires. The care with which it is made ensures uniformity of product. For high-class instruments its low temperature coefficient of resistance and thermoelectromotive force against copper render our alloy superior to any previously procurable.

BAKER & CO., INC.

PLATINUM

in all forms for all purposes
Scrap purchased or exchanged

Murray and Austin Sts., Newark, N. J.

"XDUCT"
Galvanized Conduit

Made for users who want the best. XDUCT is a high-grade conduit designed and made with a view to meeting all the requirements essential to precise work in electrical wiring.

Made from easy bending Spellerized Mild Steel Tube. Protected from rust by a heavy deposit of pure, non-corrosive zinc. Enameled inside with especially prepared black enamel which forms a smooth, glossy interior, through which the wires are easily fished.

Furnished in 10-foot lengths, reamed and threaded on both ends, with coupling on one end.

Write for Samples

AMERICAN CIRCULAR LOOM CO. TRADE MARK

American Circular Loom Co.
90 West St., New York
Boston Los Angeles Seattle
Chicago San Francisco Toronto

MAGNET WIRE
MAGNET WIRE PRODUCTS

DUDLO

The Sign of Highest Quality and Good Service

WINDINGS

Ignition	**Telephone**
Wireless	**Meter**
X-Ray	**Transformer**
Magnet	**Field**

Coils for all Electrical Work

All coils made according to specifications of customer, and guaranteed to be satisfactory.

MAGNET WIRE

Plain enameled copper wire
Single cotton enameled copper wire
Single or double cotton magnet wire
Single or double silk magnet wire
Single silk enameled copper wire

We have one of the largest and most modern plants in the world devoted to the manufacture of magnet wire and windings.

Dudlo Manufacturing Co.
Fort Wayne, Ind.

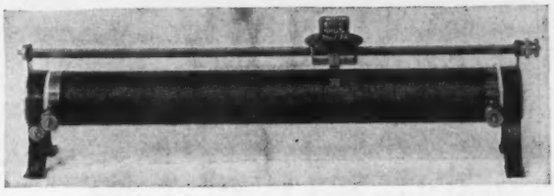
"BECBRO" RHEOSTATS

FOR

LABORATORIES

AND

POWER STATIONS



In All Types and Capacities

Send for Bulletin 520

BECK BROS.

3648 N. 2nd St., Phila., Pa.

States Portable Potential Phase Shifters

are so simply constructed that testing meters at fractional power factors can be carried out by unskilled men.

Ask for our circular No. 30— it gives full details.

THE STATES CO., 19 New Park Avenue, HARTFORD, CONN.

4

JAGABI

ADJUSTABLE RHEOSTAT

"Jagabi" Sliding Contact Tube Rheostat

A good assortment of convenient rheostats is a great asset in any laboratory—and reliable rheostats are essential for proper operation of many commercial devices.

"Jagabi" Sliding Contact Tube Rheostats are regularly made for currents from .3 ampere to 25 amperes with corresponding resistance from 3000 ohms to .7 ohm. Most requirements can be supplied from standard sizes. If unusual conditions must be met we are prepared to offer special rheostats to suit.

For comparatively heavy currents, or continuous regulation without steps, we recommend the "Jagabi" Carbon Compression Rheostats made in sizes from 250 to 3000 watts.

Write for illustrated Bulletin 936.

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1211-1213 Arch Street, Philadelphia

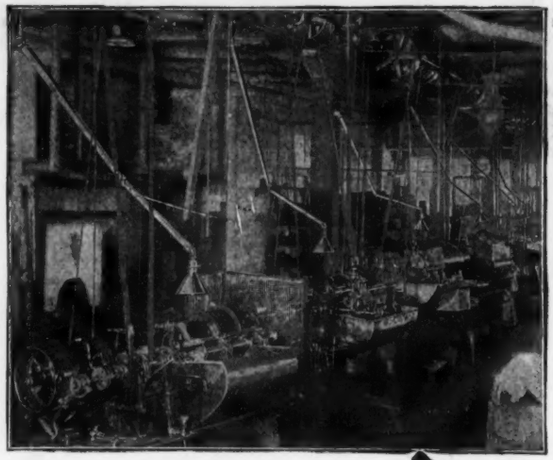
EAGLE
Renewed Tungsten Lamps

give more than twice the light of carbons at same current cost!

First cost no more than new carbons.

Write for prices and further information.

Boston-Economy Lamp Div.
National Lamp Works of General Electric Co.
43 Hospital St., Providence, R. I.



Boosting Production

That is the big thing that American Adjustable Fixtures accomplish when installed in your machine shop or factory. They bring the light to the work and enable higher intensities at low cost.

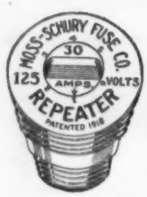
The "American" Fixture can be used for lighting any kind of work. Its construction is very substantial. All conductor wires are enclosed in the fixture arms. The universal joints enable the fixture arms to be moved in any position—and they stay put.

6 STYLES
Ceiling Fixtures
Wall Brackets
Floor Fixtures
Bench Fixtures
Machine Fixtures
Portables

Write today for details on the "American"

AMERICAN FIXTURE CO.
A. C. Runkel and Ed. R. Kiesslich, Proprs.
230 W. Water St., Milwaukee, Wis.

If the Allies Had Used Shotguns



instead of the modern repeating rifles the Germans would probably be ruling the world. But they used the latest weapons instead and you have seen the result.

The Repeater—6 Fuse Plug

Refill

is an ideal weapon with which you can beat your competitors. You can give your customers an indestructible compact fuse that will last 6 times longer than the ordinary fuse.

This fuse is entirely new. It is opening a tremendous field because it is practical and efficient.

Write for our liberal discount; it means big profits to you.

Moss-Schury Mfg. Co., Inc.
General Sales Office:
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DO IT NOW

NITROGEN WHITELITE LAMPS

There is a special significance to this apt maxim, about this time of year, when the WHITELITE lamp is in question.

You must have WHITELITES, of course. You must have the lamp that you can recommend and count upon for repeat orders. Get 'em now, while the getting is good, during the lengthening hours of daylight. Later there will be a big rush for WHITELITES. There always is.

DO IT NOW

WHITELITE ELECTRIC CO.
368-70 Broome Street,
NEW YORK CITY
Licensed under the General Electric Co's. Patents

ERIE

Fittings are rapidly replacing the old U-Bolt that always had that crude, makeshift appearance, with its many nuts that use up so much time. ERIE fittings cut your labor cost in half. They make unnecessary any Apology for Pipe Frame Construction.

Note the contact surface.

The greatest Grip with the neatest appearance.

Send for catalogue

ERIE ELECTRICAL EQUIPMENT CO.

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APPROVED
ELECTRICAL FITTINGS

APRIL, 1920

Cartridge Type, Magazine Style.
Greeff Engineering & Mfg. Co., Newark, N. J., Multiple
Electric Products Co., Inc., New York, N. Y., Sole
Agents. "Atlas," 4 in 1 non-indicating. (0-100A., 250 and
600V.)
This manufacturer is prepared to refill Atlas fuses in all sizes
including the ferrule type

INSPECTION DEPARTMENT
Associated Factory
Mutual Fire Insurance Companies,
31 Milk Street, Boston, Mass.

Official Approval

Factory Mutual's Laboratories

Facsimile of the official listing, April, 1920

A fuse that is not merely sold to you, but maintained in service thereafter, at the lowest cost of any fuse so approved.

Send for samples, prices and comparative statement showing costs of all makes based on authentic laboratory lists. Give name of your electrical dealer or distributor.

Atlas

4-in-1 Multiple Fuse

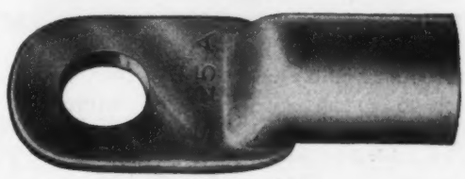
600 volt size, showing interior construction and patented silencer device.

Multiple Electric Products Co., Inc.

Sales Office: 450 Fourth Ave., New York City

Sherman Soldering Lugs

U. S. Patent **Reissue 14401**



Approved

WE have created a standard line of soldering lugs, making it unnecessary for people to use any old kind of lugs that they can get, or make their own.

A standard line that is absolutely efficient and rightly priced.

Sherman Soldering Lugs are marked with the N. E. C. rating in amperes across the flat portion at the wire end. This guarantees "approved" lugs.

Full particulars will be furnished on request.

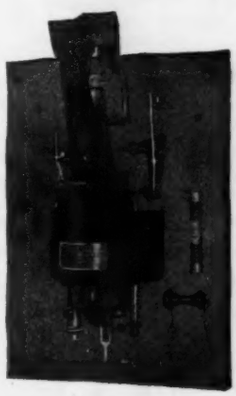
H. B. Sherman Mfg. Company

Battle Creek, Michigan

AUTOMATIC RECLOSING CIRCUIT BREAKER

"THE CIRCUIT BREAKER WITH BRAINS"

KNOWS



Not only when to open

But also WHEN TO RECLOSE

And does it AUTOMATICALLY

For the sake of

complete protection, greater safety, lower operating costs and increased production.

"Let's Get Acquainted"

The Automatic Reclosing Circuit Breaker Co.

Columbus, O.

Sole manufacturers of full automatic breakers

Electrical Alloy

Wire Ribbon Rod

COMET

Nickel Chromium Steel Resistance
Non Restricted

For Irons, Gluepots, Warmers and General Resistance Work.

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Americore

RUBBER COVERED WIRE *for* INTERIOR WIRING

Highest Standard of Excellence
Send for descriptive book

American Steel & Wire Company
Chicago - New York

Uniformity

Such things as uneven alignment, variation in resistance, unknown number of turns, etc., are impossible elements in the manufacture of coils by the method we employ. Unvarying uniformity is guaranteed.

Controller Coil

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Successors to
THE HOLMES, BOOTH & HAYDENS CO.
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SUPERIOR WEATHER PROOF "K.K." TRADE MARK ELECTRIC WIRES

Manufacturers o
"K.K." Weatherproof Wire and Cable
Bare Copper Wire and Cable
Slow Burning Weatherproof Office Annunciator and Magnet Wire

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INSULATED WIRE

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Endures the test of time, it is of high quality with great dielectric strength and resiliency.

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Organized 1898
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"American" Homogeneous Fibre Conduit
for
UNDERGROUND ELECTRIC SYSTEMS

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Sole Distributors in United States:
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This Company maintains a Special Department devoted to production of

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For Electrical Apparatus

AMERICAN SHEET & TIN PLATE CO. APOLLO SPECIAL ELECTRICAL TRADE MARK REGISTERED PITTSBURGH

APOLLO SPECIAL ELECTRICAL—High silicon alloy for high efficiency transformers; very low core losses; non-aging. Other well known grades are Extra Apollo Special Electrical, Dynamo Special Electrical, U. S. Electrical, American Armature, Pole Steel and Rotor Steel. Write us for information.

We also manufacture Sheet and Tin Mill Products of every description, including Black Sheets, Galvanized Sheets, Corrugated and Formed Sheets, Terne Plates, Etc.

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HARDSERVICE — Removes the fifty from Electric Drills

HARDSERVICE CABLE

1 Foot Saves 6

The tough, flexible WOVEN CABLE for portable lights, drills and all extension uses.

Testing samples on request.

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BRAIDING, TAPING, WINDING, TWINNING, CABLING, STRANDING, POLISHING AND MEASURING MACHINES, CABLE COVERING BRAIDERS

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MACHINES FOR

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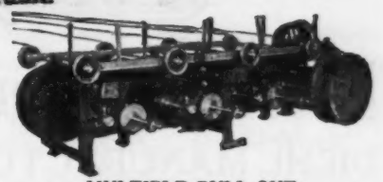
STRANDING

OF WIRE



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With TRAVERSE for 8 Reels.
Has 8 Independently Operated
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And Other Dependable Insulations

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Cut to any Size, Shape or Pattern

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Our prices will interest you

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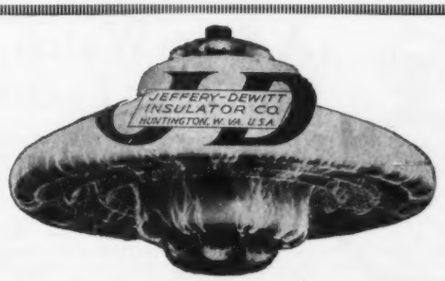

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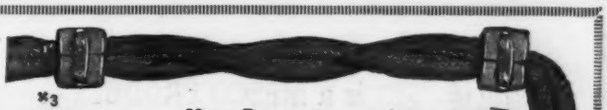
Defy
Time, Bullets, Lightning and Power Arc



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Blake Insulated Staples

Unequalled for telephone and bell wiring. The fibre insulation prevents troublesome short circuits and grounds. 4 sizes. Pat. Nov., 1900. Write for Samples.

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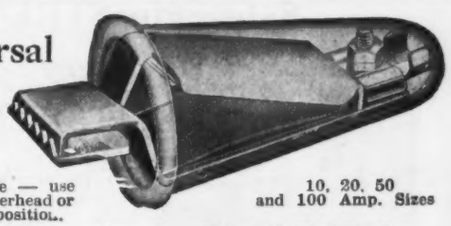

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10, 20, 50 and 100 Amp. Sizes

Time Savers In Any Electrical Work Requiring Quick Temporary Connections

Unexcelled for test sets, meters, transformer and motor test floors, shop test benches, college and commercial laboratories, motion picture projection work and storage battery charging.

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Perfect Moulded Insulation

It excels in

Heat Resistance
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Accuracy of Dimensions

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Electrical Apparatus

DIEHL MANUFACTURING CO.
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ELECTRIC WATER HEATERS
HOTVENT

"Service which has no equal"
Aetna Electric Appliance Co.
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LAMPS
—of the right quality
—at the right price
—from

Consolidated Electric Lamp Company
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NOTABLE
For Clear Enamel
For Sharp Painting
For Accurate Scaling
For Uniform Quality

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but it is not the only one as we also make

FIRE ALARM APPARATUS, SEPARABLE ATTACHMENT PLUGS, PUSH BUTTON SWITCHES, FLUSH PLUG RECEPTACLES, SNAP SWITCHES, BELLS, and then some more things at our three factories.

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Your efficiency expert will appreciate the importance of using a stop watch in your factory to ascertain correct costs of production.

We make non-magnetic stop watches in a variety of styles and dials, including decimal dials, side slide stop, ordinary stop, and fly back.

Quotations on request.

HIPP. DIDISHEIM CO., Inc.
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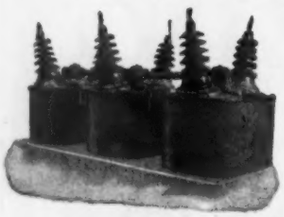

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Hand or Solenoid Control
Automatic Overload Release
Current Transformers built in.

Bulletin 100

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Safety Plus STRENGTH in every SAFETY SWITCH

All parts, like the clip shown here, are machine built. Your guarantee of real safety.

Watch for our full page ad. next week.

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VULCANIZED FIBRE

Be Sure to Specify

"Wilmington Fibre"

Sheets Rods Tubes

Special Shapes for Insulation Purposes

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Wilmington Fibre Specialty Company

Wilmington, Del. Branch Offices "Everywhere"

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is due to thorough seasoning.

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(Box 166)

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SAFETY INSULATED WIRE & CABLE CO.

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BAKELITE DILECTO

"The Perfect Insulation"

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Newark, Delaware

LAVITE Electrical Insulation

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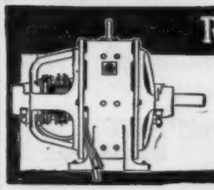

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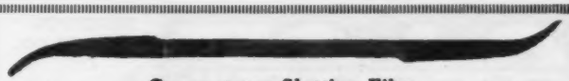

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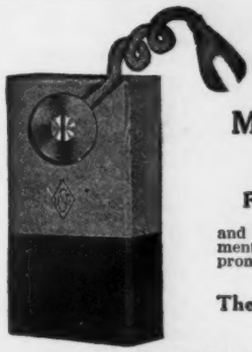
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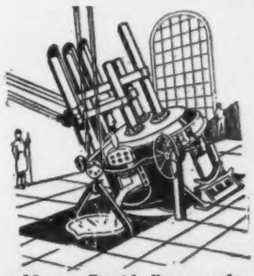
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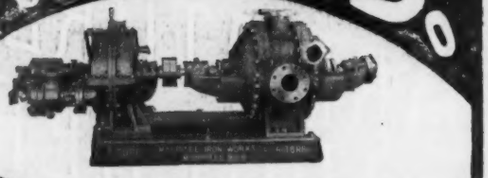

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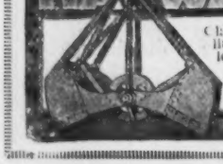

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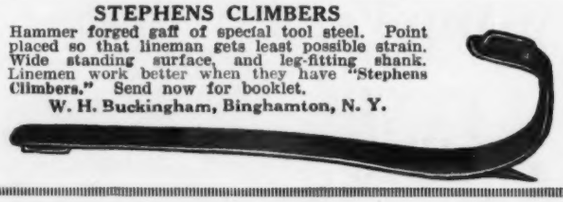

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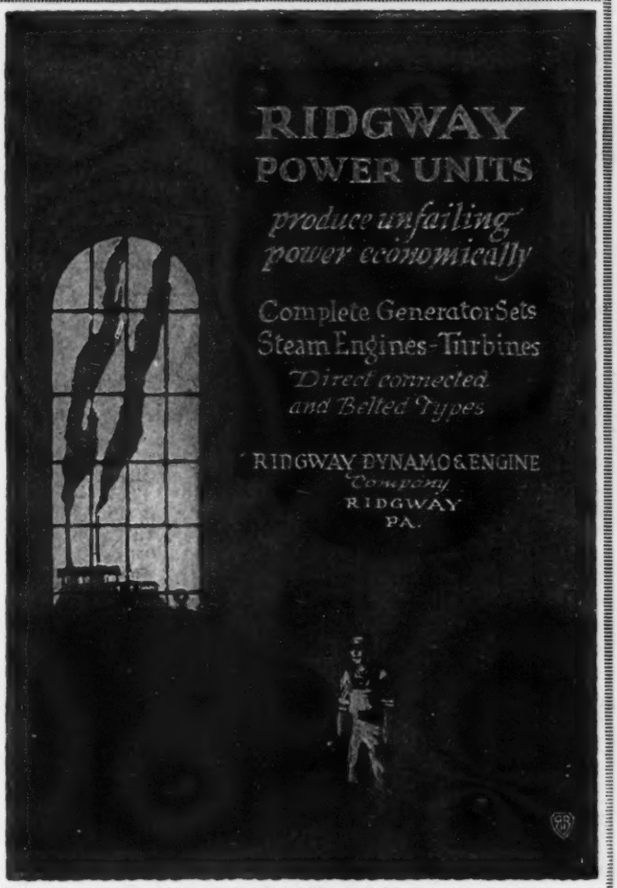

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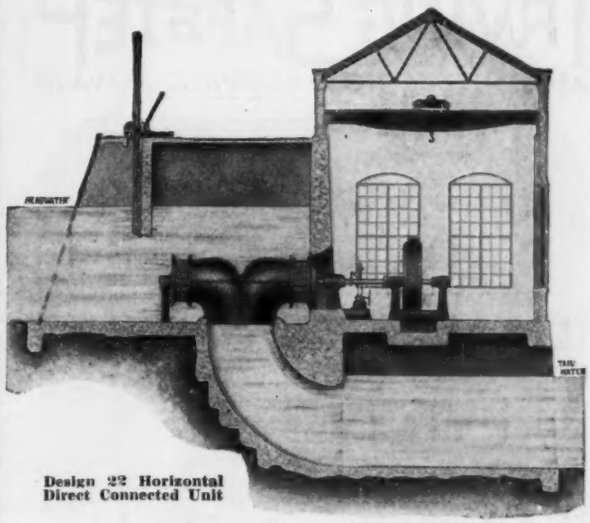
VERTICAL AND HORIZONTAL DESIGNS



Design 22 Horizontal Direct Connected Unit

Write for Bulletin 54

THE JAMES LEFFEL & CO.
SPRINGFIELD, OHIO, U. S. A.

Boston Office: Room 610 Compton Bldg., 161 Devonshire St., Boston, Mass.
S. F. Groff, 556 Woolworth Bldg., Lancaster, Pa.
H. H. White, 1503 Fourth Natl. Bank Bldg., Atlanta, Ga.
William Hamilton Co., Ltd., Peterborough, Ont., Canada

CONTINENTAL
WOOD STAVE PIPE

Growing in Popularity

From small beginning Continental has grown to tremendous popularity and enjoys wide distribution—because it is made right, of the right materials, and by experienced men.

The demand for Continental Wood Stave Pipe for Irrigation Projects, Power Companies and Municipalities the world over, necessitates ceaseless industry in our three extensive factories.

Our engineering staff is at your service.

Continental Pipe Mfg. Co.

CONTINENTAL PIPE GIVES WORLD WIDE SERVICE

General Office:
Seattle, U. S. A.

Eastern Office:
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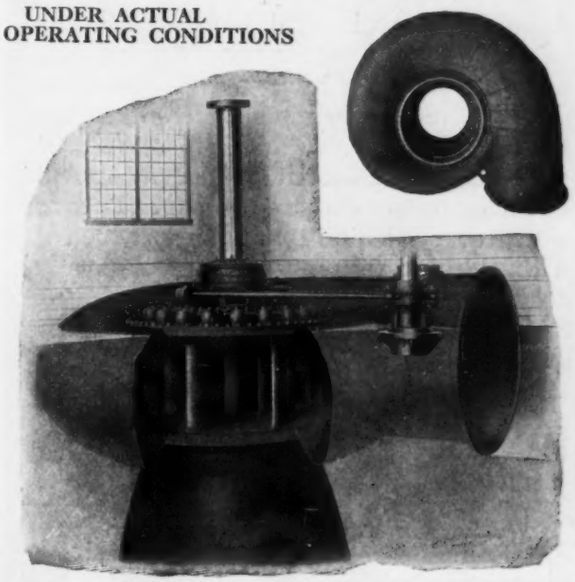
New York City

Successor to
Pacific Coast Pipe Co., Seattle
Portland Wood Pipe Co., Portland
Washington Pipe & Foundry Co., Tacoma
National Tank & Pipe Co. (Pipe Dept. Only), Portland

92% EFFICIENCY

UNDER ACTUAL OPERATING CONDITIONS



The accompanying illustration shows a single, vertical shaft wicket gate SMITH HYDRAULIC TURBINE in a plate steel scroll case with all gate operating mechanism on the outside. This unit is in successful operation under 60 ft. head developing 3,000 brake horse power at 240 revolutions. After installation it was tested by disinterested engineers and established the above performance record under actual operating conditions.

Write Dept. "W" for Bulletin of Designs

S. MORGAN SMITH CO., York, Pa.

176 Federal St. Boston **76 W. Monroe St. Chicago** **461 Market St. San Francisco** **405 Power Bldg. Montreal**

IRVING SUBWAY
THE FIREPROOF VENTILATING FLOORING

TRADE MARK
IRVING SAFSTEP
(PATENTED)
ABSOLUTELY NON-SLIPPING ALWAYS

For Indoor or Outdoor Service

A ladder or stair with *Irving Safsteps* is time-proof, weather-proof, practically accident-proof. Long wear does not destroy its non-slipping, foot-gripping surface. Snow, ice, rain, oil, grease, or soap will not make it slippery. It will not accumulate dirt and fill up. There's a degree of flexibility about it which—with the non-slipping quality—makes it easy on the feet and comfortable to use. *Safsteps* are good investments in safety and durability. Let us send Catalog 2A4.

IRVING IRON WORKS CO.
LONG ISLAND CITY, N.Y., U.S.A.

Workers in Iron and Steel to Quality Standards and Manufacturers of

TRADE MARK
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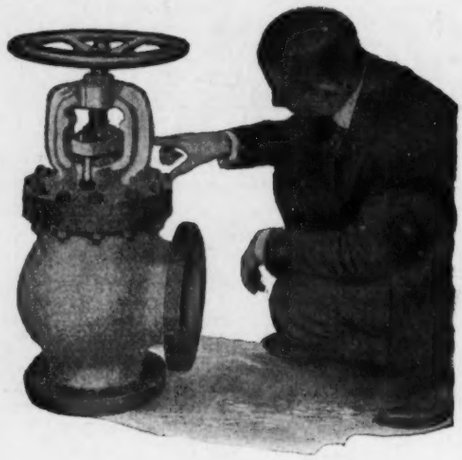
(PATENTED) REG. U.S. PAT. OFF.
THE FIREPROOF VENTILATING FLOORING



Steel Globe Valve construction that you can depend on

Sturdiness in the construction of steel globe valves that carry modern high pressures and high temperatures give an assurance against valve trouble to the plant designer and plant operator. The assurance is doubled if the valve parts insure tight seating.

This is the type of steel valve construction found in Nelson Valves.

Note the heavy construction of the one-piece bonnet and yoke which takes up the operating thrusts in this Nelson Steel Globe Valve. The full bonnet flange with through bolts gives a strong, dependable connection to the body and offers convenience in maintenance. The stem, disc and interior parts are also liberally proportioned in keeping with this safe construction.

Working parts of this valve are held in accurate alignment, insuring continuous tight seating, and the design of the disc and seat-ring eliminates wire-drawing.

These valves are made of special pressure steel castings with full monel mountings on the best specification. Their manufacture is attended with consistent care that they will render service under the most trying operating conditions.

You should know more about these valves and other types in steel, iron and bronze, shown in our valve book. Send for it today.

Nelson Valve Company
Chestnut Hill, Philadelphia, Pa.

New York: 90 West St.
Pittsburgh: Jenkins Arcade
Boston: 141 Milk St.
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Detroit: 816 Ford Bldg.
Chicago: 61 West Lake St.
Cleveland: Rockefeller Bldg.
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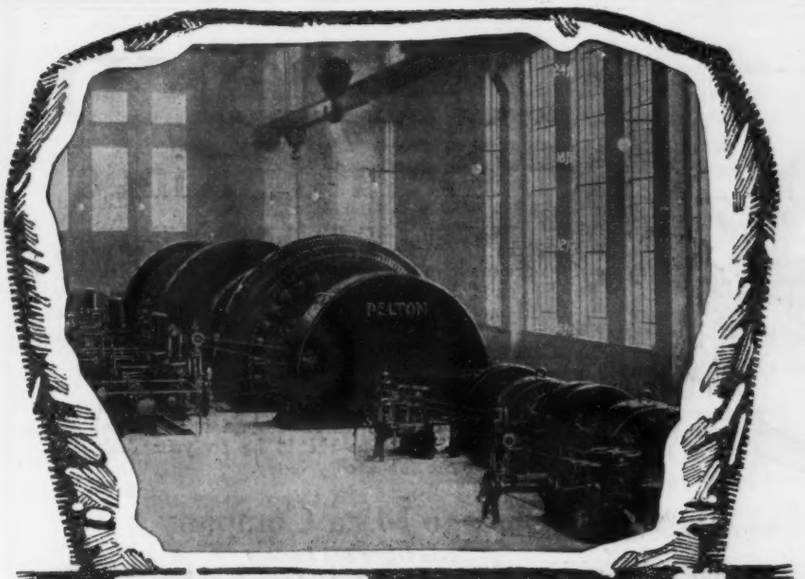
NELSON VALVES
"a safe valve investment"



The PROOF of the PUDDING

No. 19

PELTON

The City of Los Angeles, California, gets its water supply from Owens Lake, through the municipal aqueduct, 240 miles in length. Considerable power is developed in the pressure sections of the aqueduct and this power is all available for hydroelectric generation.

The first of the several plants to be erected along the aqueduct was the San Francisquito Plant No. 1, located in San Francisquito Canyon. In this plant three PELTON Impulse Turbines develop 14,000 H.P. each, under 870-foot head.

In the River Station close to the center of the City, a PELTON Impulse Turbine utilizes the power developed in the main supply line inside the City limits.

These installations have aided materially in providing funds for the retirement of the capital indebtedness.

The Pelton Water Wheel Company
1995 Harrison Street
San Francisco, Calif.
95 West Street, New York, N. Y.

Power Waste

stopped in a moment's time

You can stop sparking and loss of power at the brushes of motors and generators — A. C. or D. C. machines — and do it without the costly operation of removing armatures and placing them on a lathe. The

IDEAL Commutator Resurfacer

does the trick. It is simply an abrasive block—a manufactured article of equal density throughout. By holding it against commutators or collector rings, while machines are in motion, under full load, it cuts down ridges and high mica and stops sparking and loss of power.

Try One Out Free of Charge!

Fill out the coupon below and mail it in for a free trial. If you don't like the IDEAL after giving it a thorough trial—if it doesn't satisfy you in every way—return it to us C. O. D. The trial won't have cost you anything.

Fill out the coupon NOW and mail it in TODAY

IDEAL COMMUTATOR DRESSER CO.
6 South Dearborn Street Chicago

IDEAL COMMUTATOR DRESSER CO. EW 6-26-20
6 So. Dearborn St., Chicago

Gentlemen: Please send me an Ideal Commutator Resurfacer for free trial. It is understood that if I am not fully satisfied with it I will return it C. O. D. at no expense to me. I want to use it on equipment as follows:

Approx. R.P.M.....Diameter of Commutator or Ring.....
Approx. width of Commutator or ring surface .....
Approx. distance between brush sets.....Condition.....
Ring material (copper, steel, etc.).....
My name is.....Position.....
Company.....
Company address.....
City.....State.....

MICABOND
Commutator Rings

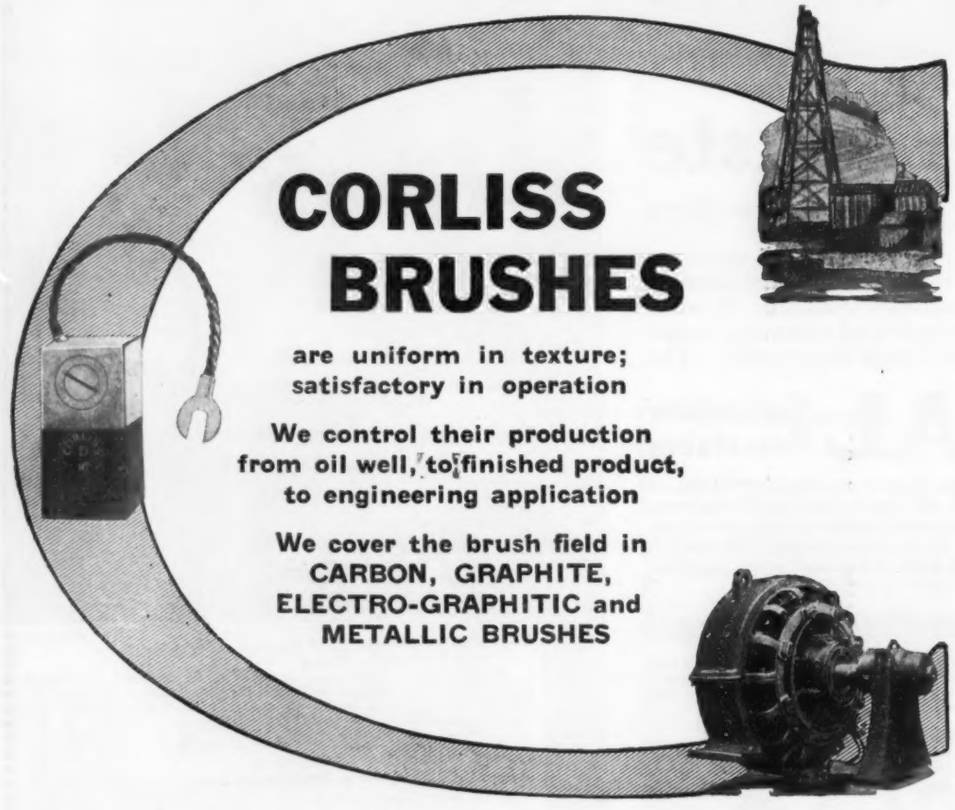
Micabond Commutator Rings can be used advantageously in the manufacture of practically every type and size of motor. These rings are made in all sizes, from ¾ in. to 30 in. diameter. The smaller sizes are used extensively in vacuum cleaner motors, dental motors, fan motors and electrical starters; the larger sizes are for farm lighting equipment and industrial motors of standard and special types.

Write for Mica Insulation Handbook.

The Mica Booklet contains valuable data on electrical insulation. It's a handbook that should be on your desk for ready reference. Write for a copy today.

Chicago Mica Company
Main Office and Factory
9-15 Campbell Street, Valparaiso, Indiana

MICABOND
The Standard Mica Insulation



CORLISS BRUSHES

are uniform in texture; satisfactory in operation

We control their production from oil well, to finished product, to engineering application

We cover the brush field in CARBON, GRAPHITE, ELECTRO-GRAPHITIC and METALLIC BRUSHES

Made at Bradford, Pa.

In the heart of the oil country where the best raw materials come from.

CORLISS CARBON CO., BRADFORD, PA.
J. F. KERLIN, President

Chicago
Pittsburgh
New York

—he pins the "Blue Ribbon" on TEXACO URSA OIL

Read his letter:-

ARIZONA GAS & ELECTRIC COMPANY
Nogales, Ariz.

April 9th, 1920

Messrs. Frazier Bros., Agents,
The Texas Company,
Nogales, Ariz.

Gentlemen—In Re: Texaco Ursa Oil

We have just given Texaco Ursa Oil a test that has convinced us as to its merits, and we'll hand the "blue ribbon" to URSA.

Owing to an accident, we had to depend entirely on one 500 HP. Diesel Engine, and we could not afford to shut down for a minute. A hot piston or valve trouble would mean disaster. For lubrication, we used Texaco Ursa Oil exclusively, and that engine ran sixty days and nights without a stop, carrying practically full load or overload all the time. When stopped, examination showed pistons, rings and valves in fine condition, with compressor and valves practically free from carbon. In fact, after a few hours to take up some bearings, it was ready for another sixty day trip.

We had hesitated about using Texaco Ursa Oil because it cost more per gallon, but the cost of lubrication is really less, because less quantity is required, and there is the absence of carbon, and "we'll say" that means something.

Yours very truly,
ARIZONA GAS & ELECTRIC CO.
(Signed) H. W. Hamblin, Genl. Engr

All
TEXACO LUBRICANTS
are of highest quality

There is a
TEXACO LUBRICANT
For Every Purpose

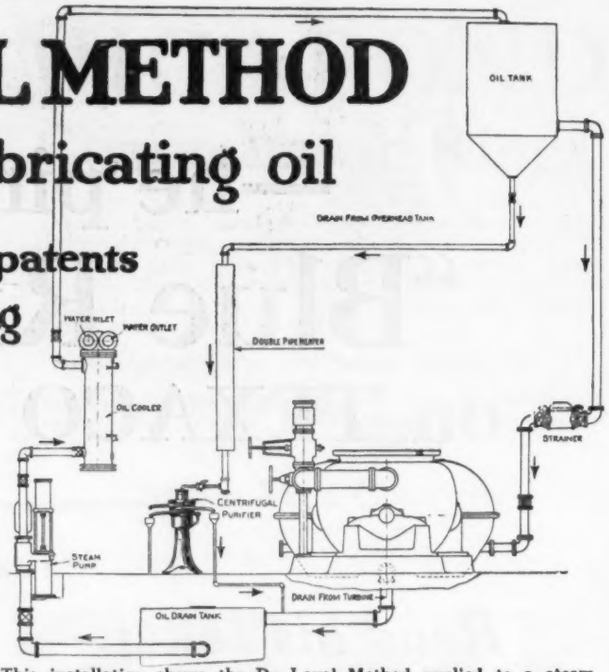
THE TEXAS COMPANY
Dept. L, 17 Battery Pl., New York City
NEW YORK CHICAGO HOUSTON
OFFICES IN PRINCIPAL CITIES

Do you receive "LUBRICATION," our monthly magazine, which we send free to Engineers, Executives, and Oil Buyers? Write for it today.

THE DE LAVAL METHOD
of purifying lubricating oil

Process fully covered by patents and patents pending

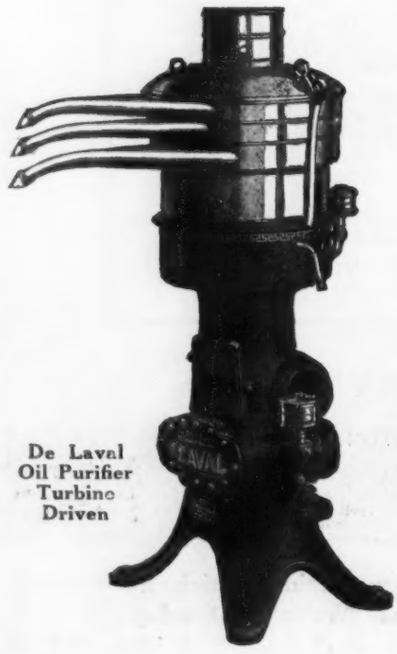
The De Laval Method of purifying lubricating oil is a simple and effective means of eliminating water, metal particles, core sand, pipe scale, carbon and other impurities from the oil. By its use, the original lubricating qualities of the oil are restored and indefinitely maintained.



This installation shows the De Laval Method applied to a steam turbine; it is equally applicable to any kind of power unit

The De Laval Oil Purifier is the result of over forty years of leadership in centrifugal engineering. The purification is instantaneous, rapid and complete, and the method is simple and inexpensive. The Oil Purifier occupies less than two square feet of floor space and requires less than two horsepower to drive. It is furnished in three sizes, each size in either electric, belt or direct steam turbine drive.

In many public service power plants, as well as large machine shops where the most modern and extensive filtering systems were in use, the De Laval Oil Purifier eliminated large quantities of impurities and water from the oil which had previously passed through the filtering systems. These concerns have since discarded filtering systems and now employ the De Laval Method exclusively. Full particulars, including names, on request.



De Laval Oil Purifier Turbine Driven

Write to nearest office for Bulletin No. 100 and users' reports

The DeLaval Separator Co.

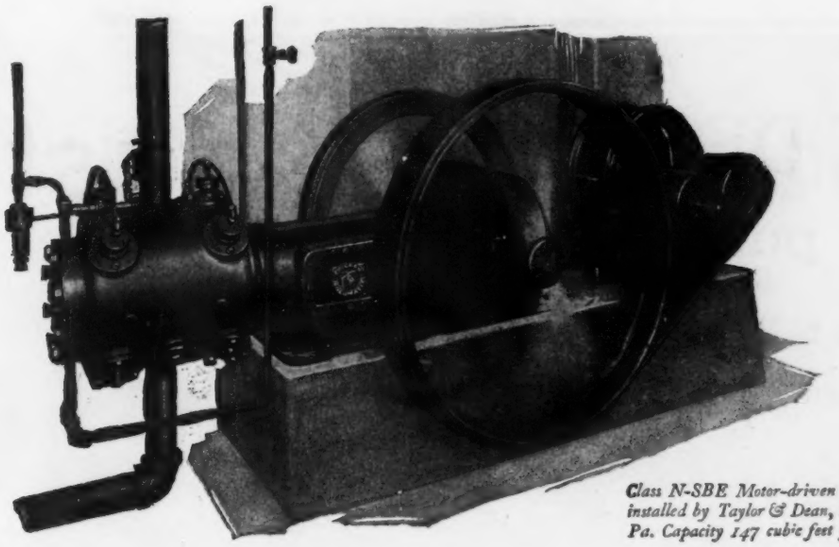
Largest Manufacturers of Centrifugal Machinery in the World

165 Broadway, New York 29 East Madison St., Chicago

DE LAVAL DAIRY SUPPLY CO.

Manufacturers' Selling Agents

SAN FRANCISCO



Class N-SBE Motor-driven Compressor installed by Taylor & Dean, Pittsburgh, Pa. Capacity 147 cubic feet per minute.

An ideal unit for moderate air power needs

CHICAGO Pneumatic Short-Belt Motor-Driven Air Compressors are ideal units for the small air power plant. Their compact construction economizes space. The short-belt drive with idler pulley prevents belt troubles

These units embody the same advanced principles of design and construction as the larger Chicago Pneumatics—Simplate Indestructible Flat Disc Valves, automatic regulation and lubrication, great rigidity, liberal bearing surfaces—all insuring more power with less waste; longer service with less upkeep.

Electric motor, steam and belt-driven types of these units are usually available from stock at the Company's branches listed below. Capacities 69 to 1197 cubic feet per minute.

Ask for Bulletin.

Chicago Pneumatic Tool Company

Chicago Pneumatic Building · 6 East 44th Street · New York

*Sales and *Service Branches all over the World*

*Birmingham *Chicago *Detroit Erie Joplin *Minneapolis *Philadelphia Richmond *Seattle Barcelona Brussels Christiania Honolulu *London *Montreal Paris Vancouver
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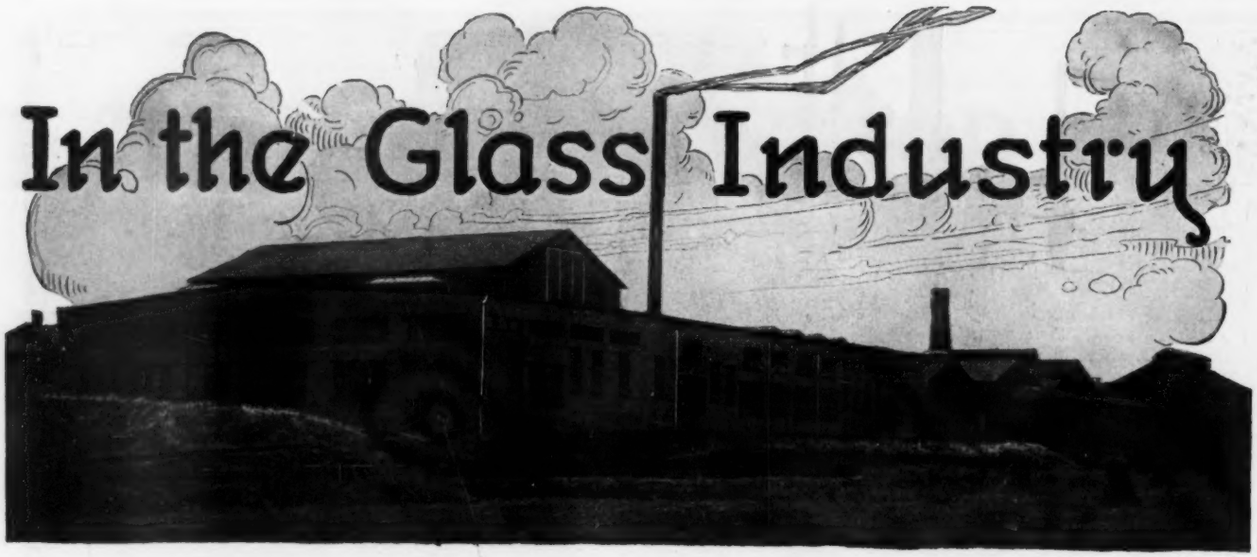
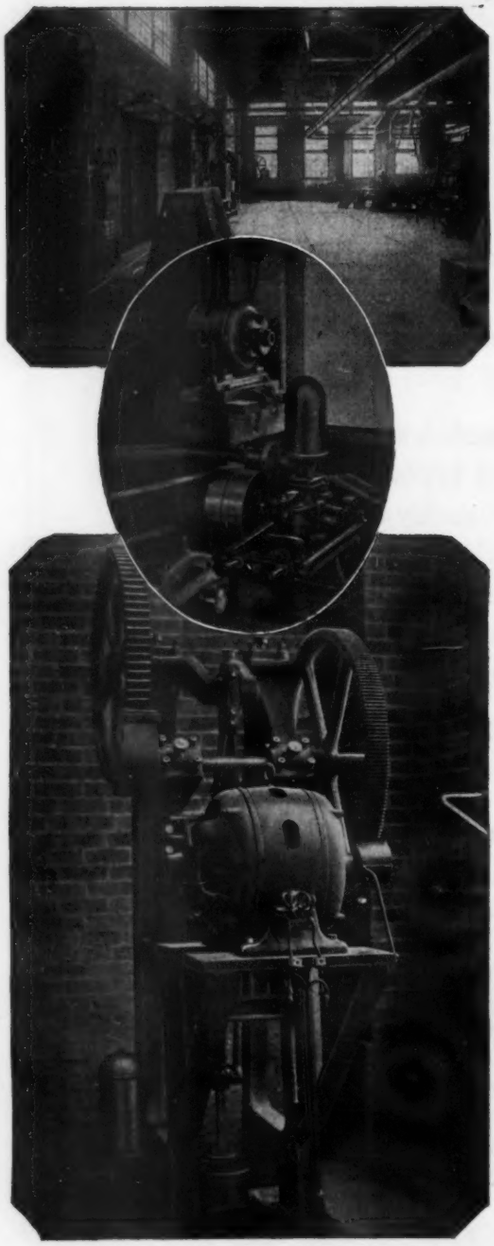
C-52

BOYER PNEUMATIC HAMMERS · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · · VACUUM PUMPS · · PNEUMATIC HOISTS,
GIANT OIL AND GAS ENGINES ROCK DRILLS · · COAL DRILLS

CHICAGO PNEUMATIC

The Compressor with the Simplate Valve





Goulds Pumps

are installed throughout the Wissmach Plant

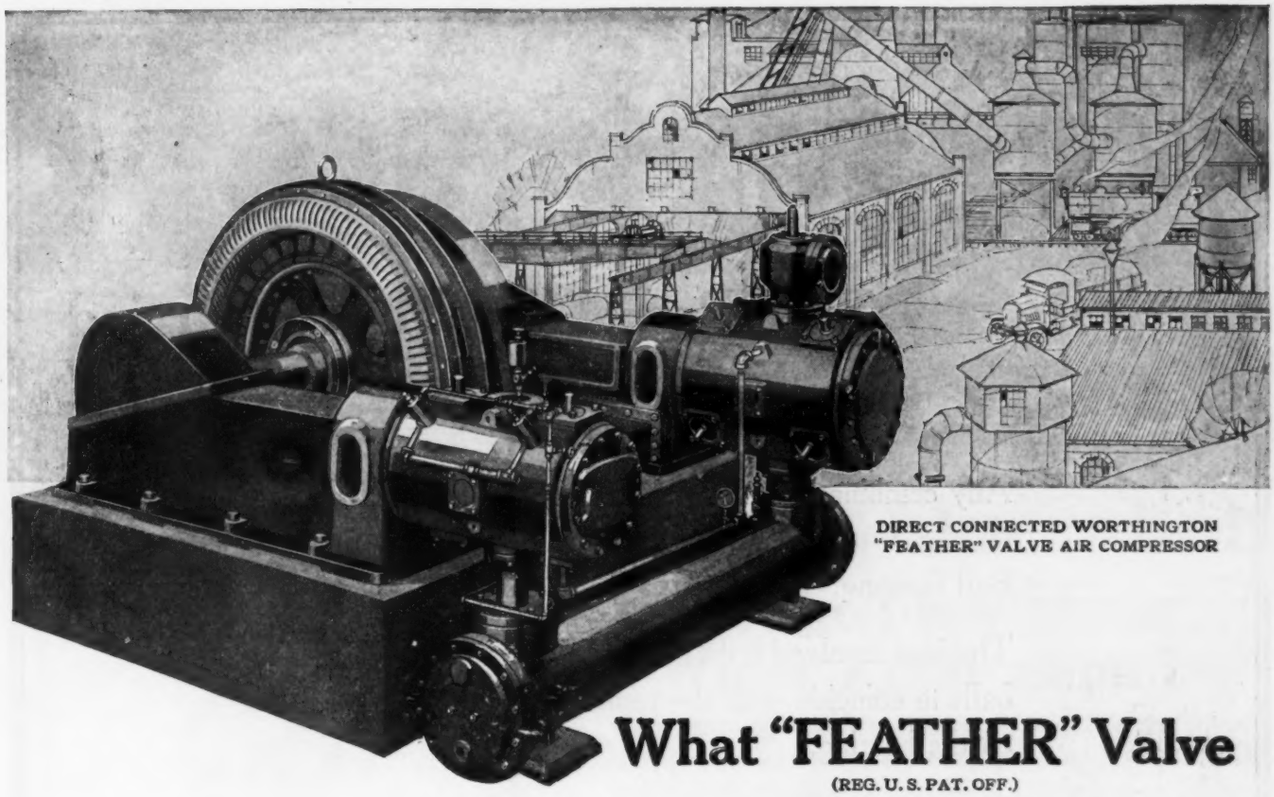
Glass manufacturers require sturdy, dependable pumps. Among the many users of Goulds Pumps in this important industry is The Paul Wissmach Glass Co., Inc., Baden City, West Va. This concern has Goulds Pumps installed throughout the plant and every Goulds is giving entire satisfaction. For eight years a Goulds "Pyramid" double-acting piston pump, driven by a one-horse-power motor, has been used for re-pumping waste water, with practically no repair work necessary.

A Goulds Centrifugal Pump, Fig. 3000, No. 8 has been giving very good service for three years re-pumping hot water. Last January the Wissmach people installed a Goulds deep-well working head, Fig. 1030, and the owners are very well pleased with this pump.

The universal satisfaction that Goulds Pumps give is the direct result of superior design and construction. Every Goulds Pump is guaranteed to satisfactorily perform the specific work for which it is sold.

Write for Bulletins

THE GOULDS MFG. CO.
Main Office and Works
Seneca Falls, N. Y.



DIRECT CONNECTED WORTHINGTON
"FEATHER" VALVE AIR COMPRESSOR

What "FEATHER" Valve
(REG. U. S. PAT. OFF.)
means to you

"FEATHER" Valve means first: COMPRESSION. It means compression that is sure, safe and always on tap. It means also, Worthington apparatus—the sort that is standard the world over, on land or sea.

Worthington "FEATHER" Valve is a thin, ribbon strip of steel, weighs less than one ounce, and has but one moving part—itself. It seats tightly on ground face slotted seats and allows air or gas to pass by bowing in center against slotted curved guards. And it functions without friction or hammering action.

Worthington "FEATHER" Valve compressors are worthy workmates with the widely known Worthington pumps and pumping machinery—world's standard since 1840.

Other Worthington Products:

Steam, Power, Centrifugal and Water Works Pumps. Meters, Oil Engines, Condensing Machinery, Air Compressors, Vacuum Pumps and Water Wheels.

WORTHINGTON PUMP AND MACHINERY CORPORATION
Executive Offices: 115 Broadway, New York City
Branch Offices in 24 Large Cities

PUMPS—COMPRESSORS—CONDENSERS—OIL & GAS ENGINES—METERS—MINING—ROCK CRUSHING & CEMENT MACHINERY

WORTHINGTON

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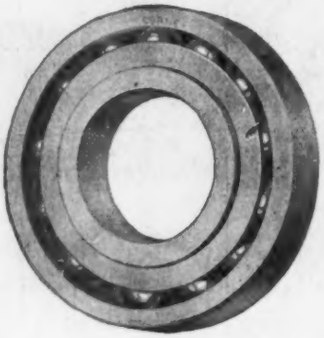


Both Radial and Thrust Carried by a Single Row of Balls

Any combination of a radial and a thrust load can be taken care of on a suitably designed single-row Gurney Ball Bearing.

The idea involved is that of inclining the load line of the balls to coincide with the resultant of the various loads on the bearing.

Carrying all loads on a single row of balls is a remarkably effective method of simplifying machine design and eliminating unnecessary weight.

Each Gurney Radio Thrust Bearing is carefully designed for the particular combination of forces under which it is to operate. The design is arrived at only after a very thorough mathematical consideration of the problem by the Engineering Department.

GURNEY BALL BEARING CO.

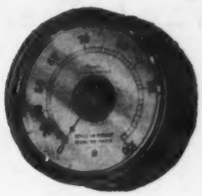
Conrad Patent Licensee

Jamestown, N. Y.

GURNEY

BALL BEARINGS

Republic Flow Meters



Electrical Operation

Gives the Flow Meter Wider Application

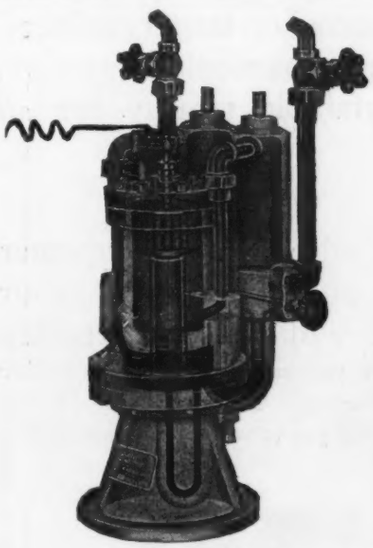
Centralizing responsibility is the surest method to obtain true economy in power plant operation.

It is of little value to practice economy in the boiler room and permit wastage of power in the engine room and in other parts of the plant.

Republic Flow Meters make possible centralized authority and responsibility. Electrical operation permits grouping the instruments on a central board at any convenient point in the plant.

The momentary output of each boiler is shown on the indicating instruments placed on the front of each boiler affording a constant guide to the fireman. The total output of each boiler and the steam consumption from each metered point is shown on the central board by the integrating instruments. The daily record of both output and consumption is permanently recorded on the recording instruments also located on the central board.

The Republic system is elastic and accurate. Bulletin No. 7 contains complete information. Send for it.



The only electrically operated Flow Meter

General offices and factory
REPUBLIC FLOW METERS CO.
565 Washington Blvd., Chicago

Republic System

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New York—Philadelphia
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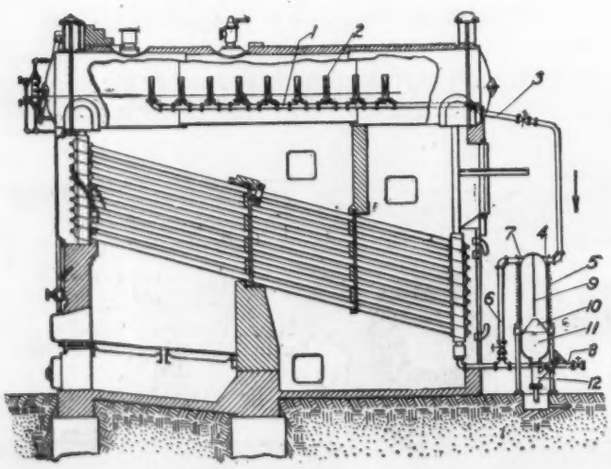
Atlanta
Republic Flow Meters Co. of Canada, Ltd., Toronto, Ont.

Description.

Temperature difference between water in boiler and water in circulation pipe 3 and settling chamber causes constant circulation in direction of arrow. Scum and foreign matter are constantly drawn from boiler and in passing slowly through settling chamber 5 sink to bottom of chamber 11, whence sediment is blown out through blow-off valve 12.



YARWAY Boiler Skimmer

(A Continuous Circulating Surface Blow)

An Economical Way to Prevent Scale

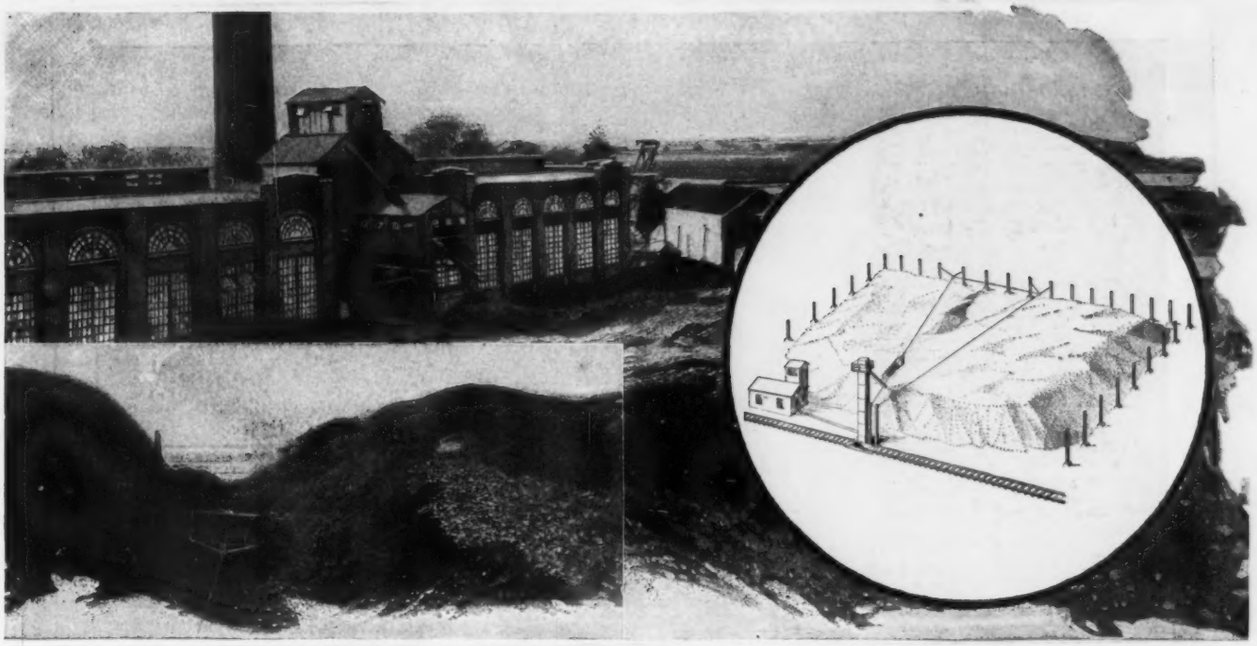
The best way to prevent boiler scale is to purify the water supply before it enters the boiler. This can be done by filtration or by chemical precipitation. However, processes of this nature are costly and difficult to maintain, and consequently in many cases impracticable.

Where feed water cannot be purified before use, the YARWAY BOILER SKIMMER is of great value not only in preventing scale, but frequently in removing existing accumulations as well. It provides a continuous surface blow, removing virtually all impurities from the surface water in the boiler. It is constructed on sound engineering principles for a particular function, and is not an infallible remedy for *all* boiler troubles.

If you will advise us of your water conditions and the type of your boiler, we will tell you frankly whether or not you can use a Yarway Boiler Skimmer to advantage. A sixty-day trial at our expense will enable you to verify our opinion without obligation.

Yarnall Waring Company
7608-20 Queen St., Chestnut Hill
PHILADELPHIA, PENNA.

Representatives in all principal cities



Store Coal For Your Plant NOW While it Can be Shipped

Beaumont
ONE CONTRACT
ONE RESPONSIBILITY

A Few Plants Using Beaumont Equipment

Wilmington & Phila. Traction Co. Wilmington, Del.

Alfred Wolstenholme & Sons Co. Philadelphia, Pa.

Philadelphia Suburban Gas and Elec. Co. Cromby, Pa.

Curtis Publishing Co. Philadelphia, Pa.

Midvale Steel Co. Coatesville, Pa. (4 contracts)

Studebaker Corp. South Bend, Ind.

State War & Navy Dept. Building Washington, D. C.

Beaumont Company specializes only on boiler houses and equipment used in their operation, and does not enter into any other kinds of engineering and construction work. It seems conservative, therefore, to claim that their organization is better qualified in size, knowledge and experience for this one class of work than any other in the country.

Picture mountains of coal—thousands of tons of it right outside your plant, with carload after carload being dumped and stored—enough coal to keep your factory going for months to come. Why not buy during the dull months of shipping and safeguard your plant against any possible future coal shortage, mine strikes or tie-ups of transportation?

All that is necessary is sufficient ground adjacent to your plant and a Beaumont Drag Scraper System for unloading the coal and hauling it out on the pile. Then, when it is needed in the boiler house, the operation is reversed.

The illustration above shows a typical Beaumont Drag Scraper System. The advantage of this system over others is apparent—low-maintenance, no necessity for skilled labor—low installation costs. Beaumont Drag Scrapers store coal in any shape area at a capacity of 50 to 75 tons an hour and at a cost of less than 1 cent a ton. Handles lump or crushed coal and if desired, the various sizes can be stored separately. This system will attack fire in any section of the storage pile, dig down to the heart of the fire so it can be easily quenched. No trestle is required in the construction.

Store coal for your plant *now*. The Beaumont book—"Drag Scraper Systems for Storing Coal" will prove of material value to executives and will be sent upon request.

R·H· BEAUMONT CO·

Coal and Ash Handling Systems for Boiler Houses

328 Arch Street **Philadelphia**

ELLIOTT-EHRHART JET CONDENSERS

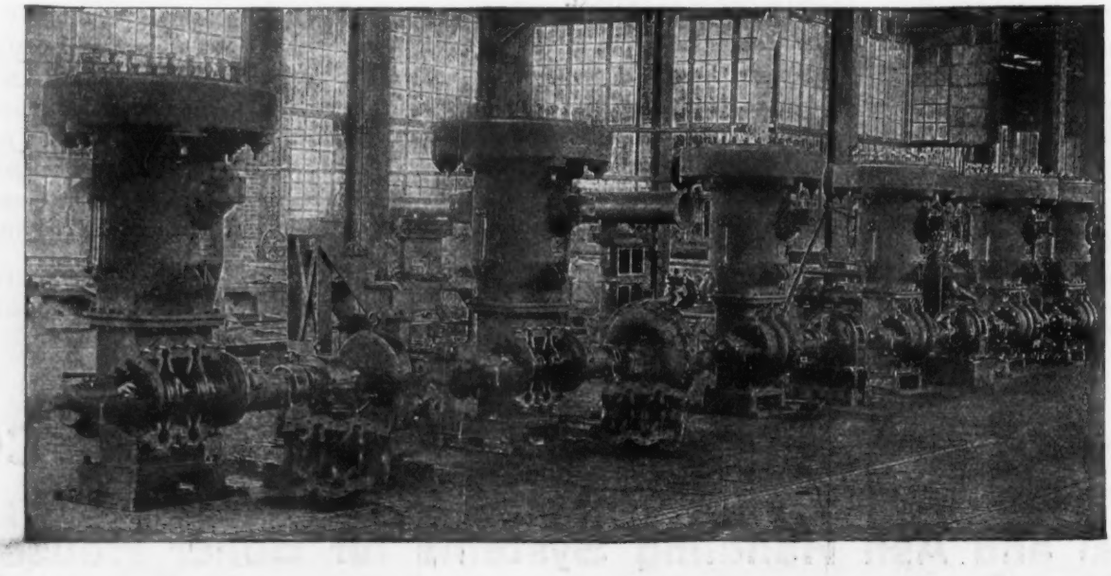
ELLIOTT-EHRHART Jet Condensers are thoroughly standardized and with the exception of rotors for pumps, nozzles for Air Ejectors and a few other minor parts which must be designed for operating conditions, all Condensers of the same size are alike and all parts are interchangeable.

The advantage of standardized construction lies in the ability of the manufacturer to furnish repair parts from stock in case of a breakdown or accident, or in case of having more than one condensing unit of a size in the same plant, extra parts serve as spares for all units.

The accompanying photographs show part of a stock order for Elliott-Ehrhart Jet Condensers almost ready for the testing floor.

When you are in the market for Condensers, let us tell you about Elliott-Ehrhart Condensers, Jet Surface and Barometric.

ELLIOTT COMPANY, 442 Fifth Ave., Pittsburgh, Pa.



The Taylor Stoker

MORE THAN A STOKER—
a Complete System of Combustion

Continued on next three pages

Quitting or

"If I try to force those boilers much above rating, my men quit on me," said the Chief Engineer in the Detroit Sulphite Pulp & Paper Co. plant, pointing to one end of his boiler aisle. The boilers at which his finger levelled were equipped with mechanical stokers.

"Why so?" asked a visitor.

"Because the firemen have so much poking and shoving to do," he answered. "Now with these stokers," he turned to the boilers near at hand equipped with Taylor Stokers, "even if the boilers are forced to 300% of rating, the firemen's work isn't increased in the slightest."

Smokeless Town Is

Sticking-Which?

Operating men know that equipment with mechanical stokers is not necessarily a guarantee that the labor problem is solved. There are stokers and stokers. Some stokers require almost as much labor as hand-firing.

When the Taylor Stokers went into this Detroit plant, for instance, certain firemen who had been on the job with the other stokers persisted in throwing open the observation doors on the Taylor Stokers and poking and shoving the fire, thus exposing the tuyere plates which the Taylor System automatically keeps blanketed with green coal. These firemen thought that poking and barring was a necessary adjunct of mechanical stoking. "I thought I'd have to put padlocks on those observation doors," the Chief said. "But finally we persuaded the firemen that the Taylor Stokers are made to be let alone."

This plant consists of eight 258 h.p. units. Four of these are now fired by Taylor Stokers.

Because of the labor advantage which the Chief refers to, and because Taylor Stokers will operate the boilers at greater capacity on poor coal than the other stokers will operate them on good coal, the four remaining boilers will shortly be equipped with Taylor Stokers also.

The Taylor Stoker

really solves the labor problem. One man easily cares for from 5,000 to 10,000 h.p. equipped with Taylor Stokers, and has no strenuous job, either. It is a job calling on his intelligence instead of his muscle—a job that appeals to a man—a job he likes to stick to.

The Taylor Stoker solves the coal problem. It is first in coal-burning efficiency.

The Taylor Stoker solves the capacity problem, and the variable load problem. Ask the responsible men in any Taylor-Stokered plant what the Taylor has done in these respects. Ask them also their opinion of Taylor Stoker *service.*

Send today for the booklet, "Today's Problems and the Taylor Stoker."

American Engineering Co., Philadelphia, Pa.

The Taylor Stoker Co., Ltd., Toronto, Canada

The Taylor Stoker

These, too, are Taylor-Stokered

American Smelting & Refining Co.
Arlington Mills
Atlantic City Electric Co.
Atlantic Sugar Refineries, St. Johns, N. B.
Atlas Cement Co.
Baltimore Copper Smelting & Rolling Co.
Boston Elevated Railway Co.
J. G. Brill Co.
Brooklyn Edison Co.
Champion Fibre Co.
Chickasaw Shipbldg. Co.
Columbia Chemical Co.
Cuban American Sugar Co.
Cumberland Edison Co.
Everett Mills
Globe Soap Co.
John Hopkins University
Inland Steel Co.
Iowa Railway & Light Co.
Louisville Cement Co.
Luken Steel Co.
Michigan Alkali Co.
National Lead Co.
National Tube Co.
Oxford Paper Co.
Pennsylvania Shipbldg. Co.
Philadelphia Rubber Works
Pittsburgh Plate Glass Co.
Potomac Electric Power Co.
Ray Consolidated Copper Co.
Republic Iron & Steel Co.
Riverside & Dan River Cotton Co.
Standard Steel Car Co.
State, War & Navy Bldg.
Tennessee Coal, Iron & R. R. Co.
Union Bag & Paper Co.
United Illuminating Co.
U. S. Coal & Coke Co.
U. S. National Museum
U. S. Steel Corporation
Wardlow-Thomas Paper Co.
Wilmington & Phila. Traction Co.

American Engineering Company

Philadelphia, Pa.

Taylor Stoker Co., Ltd., Toronto, Canada

SERVICE

Riley Stoker Service *is more* than a cost transaction which places a given amount of equipment in your plant leaving it at your mercy ever after.

Riley Stoker Service *begins at the source;* takes your needs into consideration and *stays with you* as long as your equipment is in operation.

Before installation our engineers carefully investigate the conditions for each installation and design the equipment exactly suited to those needs. Should special developments be desired then our designing department is at your disposal.

After installation our field engineers periodically follow up each plant whether it needs it or not. They are always ready to advise, direct and remedy.

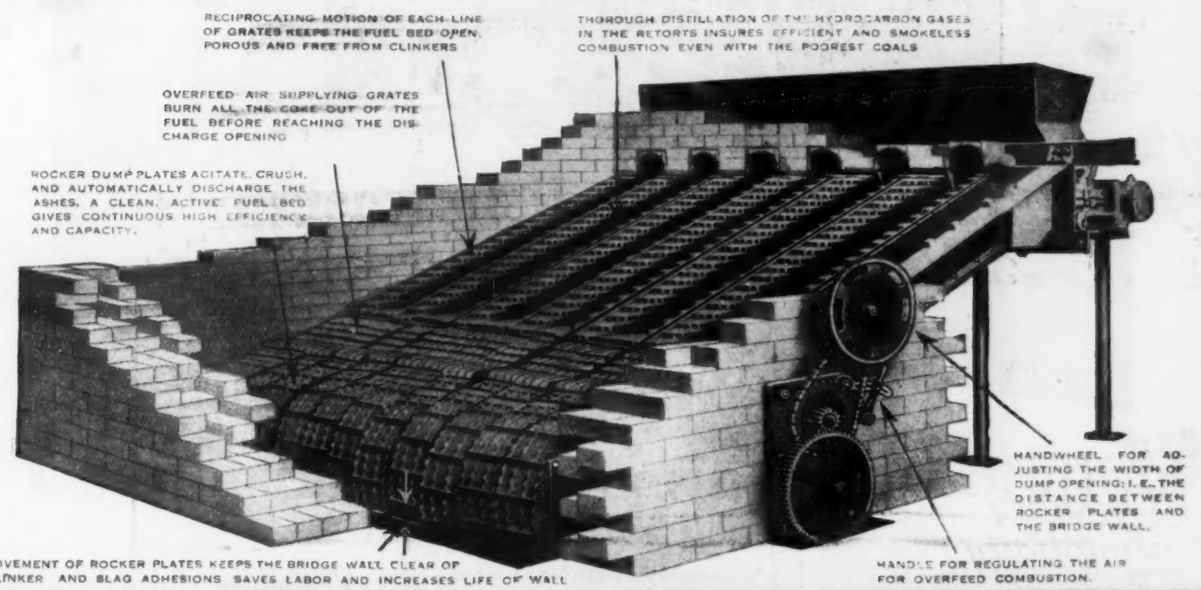
Unusual as it may seem, our sales engineers are not so much interested in volume of sales—as satisfactory operation.

This policy protects present, as well as future customers. It is the customers' assurance that if they need advice on the operation of present equipment, or on the selection of new equipment, they can count on our being ready to serve them.

Bear in mind that the spirit of the service rendered by Riley Stoker engineers is constructive, not arbitrary nor forced, but designed as a co-operative influence to achieve the best possible results not only before but after purchase.

Catalog E-6 sent on request.

SANFORD RILEY STOKER COMPANY, WORCESTER, MASS.


RECIPROCATING MOTION OF EACH LINE OF GRATES KEEPS THE FUEL BED OPEN, POROUS AND FREE FROM CLINKERS
THOROUGH DISTILLATION OF THE HYDROCARBON GASES IN THE RETORTS INSURES EFFICIENT AND SMOKELESS COMBUSTION EVEN WITH THE POOREST COALS
OVERFEED AIR SUPPLYING GRATES BURN ALL THE COKE OUT OF THE FUEL BEFORE REACHING THE DISCHARGE OPENING
ROCKER DUMP PLATES AGITATE, CRUSH, AND AUTOMATICALLY DISCHARGE THE ASHES. A CLEAN, ACTIVE FUEL BED GIVES CONTINUOUS HIGH EFFICIENCY AND CAPACITY.
HANDWHEEL FOR ADJUSTING THE WIDTH OF DUMP OPENING; I. E., THE DISTANCE BETWEEN ROCKER PLATES AND THE BRIDGE WALL.
MOVEMENT OF ROCKER PLATES KEEPS THE BRIDGE WALL CLEAR OF CLINKER AND SLAG ADHESIONS SAVES LABOR AND INCREASES LIFE OF WALL
HANDLE FOR REGULATING THE AIR FOR OVERFEED COMBUSTION.

TRADE MARK Rx REGISTERED

RILEY UNDERFEED STOKERS

TRADE MARK Rx REGISTERED

EASE OF

The electrical dish washer is a labor saver in the kitchen

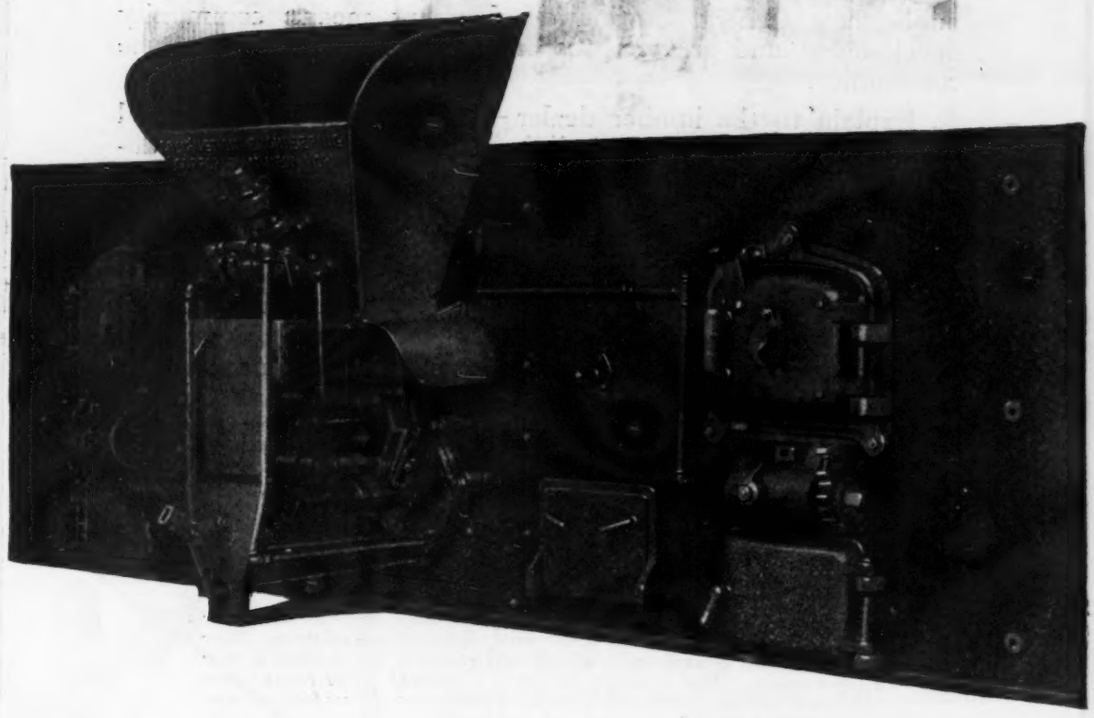
Economy
Capacity
Simplicity
Ease of Operation
Ease of Installation

OPERATION

TYPE E STOKERS

STANDARD WHEREVER COAL IS BURNED

for saving labor in the boiler room



Combustion Engineering Corporation

11 Broadway, New York City

Owners and Manufacturers of

Type E Stokers—for Bituminous Coal

The Grieve Grate—Hand-Firing Coxe Stokers—Anthracite Coal and Coke Breeze

PHILADELPHIA, PA. PITTSBURGH, PA. MINNEAPOLIS, MINN. BIRMINGHAM, ALA.
HAZLETON, PA. BOSTON, MASS. CHICAGO, ILL. DENVER, COLO. SALT LAKE CITY, UTAH ALBANY, N. Y.
DETROIT, MICH. OMAHA, NEB. MILWAUKEE, WIS.
TAYLOR ENGINEERING CO., VANCOUVER, B. C.

$1,400,000 for Lumbermen

Without Central Station development to provide for new demands for electrical service, how can the electrical contractor, the electrical equipment manufacturer or the electrical dealer hope for expansion in his own branch of the industry?

Since this is the case and since the utilities must look to the public for relief from existing conditions, every electrical man should do his share toward molding public opinion favorable to the utilities.

This is best accomplished by showing each individual of the public how Central Station development means community development and greater prosperity for every member of the community.

Explain to the lumber dealer—for example, how electrical development affects home building. In Fresno County, California, a home building program amounting to over $10,000,000 is being held up on account of the impossibility of extending electrical service. Of this amount 14%, or $1,400,000 will eventually be spent for lumber—but not until the Central Station waiting to serve this territory is permitted to finance new electrical development.

Lumber dealers everywhere can not help but be impressed by facts like this. And what applies to the lumber men applies to a certain extent to every other individual, regardless of his position in the industrial world.

Carry facts like this to the public. Help the utilities prosper, and every member of the electrical industry will prosper proportionally.

The executives of the Green Engineering Company appreciate that public interest is not served when Utilities merely exist—they must thrive. Their earnings must be sufficient to extend their service to new sections of their communities. New customers cannot be considered unless returns from territories already served show a profit. A realization of these facts prompts us to publish this advertisement.

GREEN ENGINEERING CO.,

Main Offices and Shops:

East Chicago, Indiana

This is the fifth of a series of advertisements written as an aid to the betterment of the entire electrical industry.

Ellington MOTORS

The Motor for the Home

It is not good judgment to foster upon the housewife a motor driven machine that is beautiful in appearance and thorough in action but driven by an inferior motor.

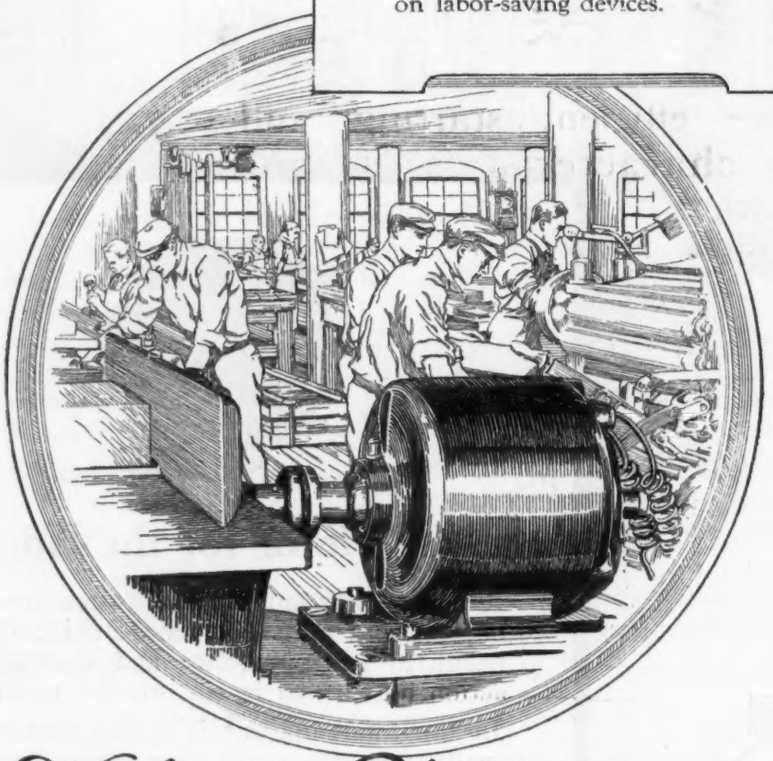
In the final analysis it is the motor that really does the work that formerly made housekeeping a tiresome and irksome drudgery.

The household appliance that is driven by the Ellington small motor is a dependable outfit—one on which you can safely stake and make a reputation for your product.

THE ELLINGTON ELECTRIC CO.
QUINCY, ILL.

Manufacturers of
Unit Chargers—Industrial Motors—Fractional H. P. Motors

BUILT to coördinate precisely with the work they are to do; with vibration eliminated by scientific balancing; uniform in speeds, yet adaptable to all load fluctuations; durably insulated, and amply protected from dust and moisture; made-to-order HOLTZER-CABOT electric motors assure the maximum of successful service wherever used on labor-saving devices.



Holtzer-Cabot Motors

THE HOLTZER-CABOT ELECTRIC CO.

BOSTON, MASS.

CHICAGO NEW YORK BALTIMORE
DETROIT PHILADELPHIA ST. LOUIS
MINNEAPOLIS

Century

Repulsion Start—Induction

Single Phase Motors

They have efficient starting and operating characteristics, no one characteristic being over developed at the expense of another. The low starting current (275% full load current) and high powor factor (75% to 90%) impose less demand upon transformers and transmission lines, which materially assist in maintaining good voltage, and consequently good starting torque.

A fuse which will protect the motor while running and carrying its load, is usually of ample capacity for starting.

Ratings

1/10 to 40 Horse Power

CENTURY ELECTRIC CO.

St. Louis, Mo., U. S. A.

Sales Offices in Principal Cities

The Pioneer Non-Sparking Motor

Some 40 years ago E-D engineers announced to the world the first successful non-sparking direct current motor—the E-D Inter-Pole. Since that time it has been widely imitated.

But E-D set the pace, and we are confident that the E-D Inter-Pole Motor of today, embodying the developments and refinements of the ensuing years, is representative of the highest attainment in sparkless commutation.

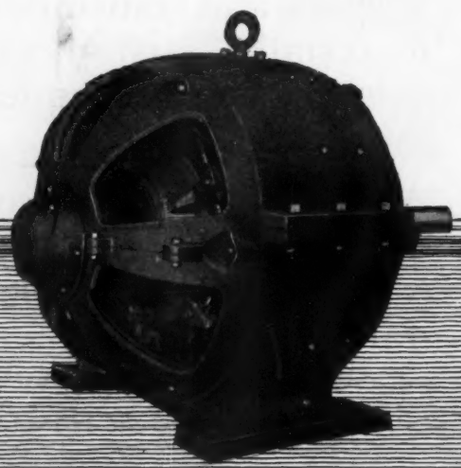
Get acquainted with the entire line of E-D motors and generators—A.C. ¼- to 200-hp.; D.C. ½- to 300-hp. It has a time-tested record for dependable service. Write for Catalogs.

Electro Dynamic Company, Bayonne, N. J.

BRANCH OFFICES

Philadelphia, Bulletin Building
Pittsburg, Oliver Building
Chicago, Peoples Gas Building
New York, 11 Pine Street
Cleveland, Marshall Building
Detroit, Book Building
Wilkes-Barre, Second Natl. Bank Bldg.
Allentown, Hunsicker Building
Boston, 88 broad Street
Washington, D. C., 806 12th Street

2018-I



Electro Dynamic Motors

WHAT AND WHERE TO BUY

Equipment, Apparatus and Supplies Advertised in this Issue with Names of Manufacturers and Distributors

Air Compressors
Allis-Chalmers Mfg. Co.
Black & Decker Mfg. Co.
General Electric Co.
Hartford Mach. Screw Co.
Worthington Pump & Machy. Corp.

Air Washers and Coolers
Spray Engrg. Co.

Ammeters and Voltmeters, (See Instruments, Electrical.)

Anchors, Guy
Hubbard & Co.
Matthews & Bro., Inc., W. N.

Annunciators
Ostrander & Co., W. R.

Arches, Boiler
Green Engineering Co.

Armature Repair Machinery
Electric Service Supplies Co
Johns-Manville Co., H. W.

Battery Changing Apparatus
Cutler-Hammer Mfg. Co.

Batteries, Dry Cell
Manhattan Elec'l Supply Co.
Western Electric Co.

Batteries, Storage
Electric Storage Battery Co.

Battery Charging Apparatus
Cutler-Hammer Mfg. Co.
General Electric Co.
Ward Leonard Electric Co.
Wesche Electric Co., B. A.
Westinghouse Elec. & Mfg. Co.

Bearings, Ball
Gurney Ball Bearing Co.
Norma Co. of America

Bells
Electric Signal Mfg. Co.
Ostrander & Co., W. R.

Belt Conveyors
Link-Belt Company

Belting Leather
Ladew Co., Inc., Edw. R.

Blowers, Steam Driven
Mechanical Appliance Co.
Terry Steam Turbine Co.

Boilers, Steam
Babcock & Wilcox Co.
Edge Moor Iron Co.

Bolts, Expansion
Hubbard & Co.
Star Expansion Bolt Co.

Bolts and Nuts
Sturtevant Co., B. F.

Bond Testers
Roller-Smith Co.

Books, Technical
McGraw-Hill Book Co., Inc.

Boosters
Allis-Chalmers Mfg. Co.
General Electric Co.
Ridgway Dynamo & Eng. Co.
Wesche Electric Co., B. A.
Westinghouse Elec. & Mfg. Co.

Boxes, Fuse
General Electric Co.
Johns-Manville Co., H. W.
Matthews & Bro., Inc., W. N.
Metropolitan Elec. Prod. Co.
Westinghouse Elec. & Mfg. Co.

Boxes, Junction and Outlet
Appleton Electric Co.
Chicago Fuse Mfg. Co.
Crouse-Hinds Co.
D. & W. Fuse Co.
G. & W. Elec. Specialty Co.
General Electric Co.
National Metal Molding Co.
Westinghouse Elec. & Mfg. Co.

Boxes, Meter and Service
General Electric Co.
Johns-Manville Co., H. W.
Metropolitan Elec. Prod. Co.

Brackets and Pins, Metal
Hubbard & Co.
Philadelphia Elec. & Mfg. Co.
Pittsburgh Transformer Co.
British Government Prop. Listed in Adv.

Brushes, Dynamo
Corliss Carbon Co.
Jeandron, W. J.
United States Graphite Co.

Buckets, Clam Shell
Blaw-Knox Co.
Orton & Steinbrenner Co.

Buckets, Excavating, Motor-Driven
Hayward Co.
Link-Belt Company

Buildings, Steel
Milliken Bros. Mfg. Co., Inc.

Bus Bar Supports
Delta Star Electric Co.
Lewis & Roth Corp.
Westinghouse Elec. & Mfg. Co.

Bushings
National Fibre & ns. Co.
National Metal Molding Co.
Siemon Hard Rubber Co.

Cable Accessories
Standard Underground Cable Co.

Cable End Bells
Electrical Development & Mach. Co.
Lewis & Roth Corp.
Westinghouse Elec. & Mfg. Co.

Cable Racks
Hubbard & Co.
Metropolitan Elec. Prod. Co.

Cable, Splicing Joints
Dossert & Co., Inc.

Cabling Machinery
American Ins. Machinery Co.
New England Butt Co.

Carbon Brushes
Corliss Carbon Co.
Jeandron, W. J.
United States Graphite Co.

Castings
International Nickel Co.

Castings, Brass
Nelson Valve Co.

Castings, Die
Precision Casting Co.

Chains, Silent Driving
Link-Belt Company
Morse Chain Co.

Chains, Silent Power Transmission
Morse Chain Co.

Circuit Breakers
Automatic Reclosing Circuit Breaker Co.
Condit Electrical Mfg. Co.
General Electric Co.
Industrial Controller Co.
Roller-Smith Co.
Sangamo Elec. Co.
Sundh Elec. Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Clamps, Cable Supporting
Matthews & Bro., Inc., W. N.

Clamps, Ground Connection
Condit Electrical Mfg. Co.
Dossert & Co., Inc.
General Electric Co.

Clamps, Guy
Hubbard & Co.
Matthews & Bro., Inc., W. N.

Cleats
Blake Signal & Mfg. Co.
Imperial Porcelain Co.
National Metal Molding Co.
Thomas & Sons Co., R.

Climbers, Linemen's
Buckingham, W. H.

Clips, Cable
Condit Electrical Mfg. Co.
Hubbard & Co.

Clips, Testing
Mueller Elec. Co.

Clusters
Hubbell, Inc., Harvey

Clutches, Friction
Link-Belt Company

Clutches, Magnetic
Cutler-Hammer Mfg. Co.

Coal and Ash Handling Machinery
Blaw-Knox Co.
Green Engineering Co.
Hayward Co.
Link-Belt Company
Pulverized Fuel Equip. Corp.

Cold Storage Systems
Link-Belt Company

Coil Winding Tools
Electric Service Supplies Co.

Coils
Coto-Coil Co.
Dudlo Mfg. Co.

Coils, Armature, Fields
D. & W. Fuse Co.

Coils, Choke
Delta-Star Elec. Co.
General Electric Co.
Lewis & Roth Corp.
Westinghouse Elec. & Mfg. Co.

Commutator Stones
Ideal Commutator Dresser Co.
Martindale Elec. Co.

Commutators
Cameron Electric Mfg. Co.

Compounds Commutator
McLennan & Co., K.

Condensers
Allis-Chalmers Mfg. Co.
Elliott Company
Griscom-Russell Co.
Manistee Iron Works
Westinghouse Elec. & Mfg. Co.
Wheeler Condenser & Eng'g Co.
Worthington Pump & Machy. Corp.

Conduit Bends
American Conduit Co.
Fibre Conduit Co.

Conduit Fittings
Appleton Electric Co.
Chicago Fuse Mfg. Co.
Fibre Conduit Co.
Hart & Hegeman Mfg. Co.

Conduits, Interior
American Circular Loom Co.
Austin Co., M. B.
National Metal Molding Co.

Conduits, Underground (Fibre)
American Conduit Co.
Fibre Conduit Co.
Johns-Manville Co., H. W.

Connectors and Terminals
Dossert & Co., Inc.
Lewis & Roth Corp.
Sherman Mfg. Co., H. B.
Westinghouse Elec. & Mfg. Co.

Connectors, Solderless
Westinghouse Elec. & Mfg. Co.

Contact Rail Material
Electric Service Supplies Co.

Controllers, Motor
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Monitor Controller Co.
Sundh Elec. Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Conveying Machinery (Coal Ashes, Etc.)
Green Engineering Co.
Link-Belt Company.
Orton & Steinbrenner Co.

Cooking Appliances, Electric
Estate Stove Co.

Cooling Ponds, Spray
Spray Engrg. Co.
Yarnall-Waring Co.

Cord Adjusters
American Vule. Fibre Co.
National Fibre & ns. Co.

Cord, Arc Lamp
Samson Cordage Works.

Cord, Flexible
Belden Mfg. Co.
Lowell Ins. Wire Co.
Rome Wire Co.

Cord, Telephone
Stromberg-Carlson Tel. Mfg. Co.

Cord, Trolley
Samson Cordage Works

Cords, Portable
Flexible Woven Cable Co.

Couplings, Flexible
Smith & Serrell

Couplings, Rigid (Shaft)
Smith & Serrell

Crane Motors
Westinghouse Elec. & Mfg. Co.

Cranes, Locomotive
Link-Belt Company
Orton & Steinbrenner Co.

Cranes, Traveling
Maris Bros.

Cross Arms
Hubbard & Co.
Thomas & Sons Co., R.
Western Electric Co.

Crushers, Coal and Coke
Link-Belt Company

Cutouts
Chicago Fuse Mfg. Co.
Condit Electrical Mfg. Co.
D. & W. Fuse Co.
General Electric Co.
Hart & Hegeman Mfg. Co.
Matthews & Bro., Inc., W. N.
Metropolitan Elec. Prod. Co.

Dials, Instrument Scales
D. & G Dial Enameling Co.

Drills, Brick
Hubbard & Co.

Drills, Portable Electric
Black & Decker

Dynamos and Motors
Allis-Chalmers Mfg. Co.
Burke Elec. Co.
Century Electric Co.
Colonial Fan & Motor Co.
Diehl Mfg. Co.
Electro Dynamic Co.
Ellington Electric Co.
Emerson Elec. Mfg. Co.
Holtzer-Cabot Elec. Co.
Howell Elec. Motors Co.
Kimble Electric Co.
Mechanical Appliance Co.
Peerless Electric Co.
Reliance Elec. & Eng'g Co.
Ridgway Dynamo & Eng. Co.
Robbins & Myers Co.
Roth Bros. & Co.
Wagner Elec. Mfg. Co.
Wesche Electric Co., B. A.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
Wooten Co., L. E.

Ebony, Asbestos Wood
Johns-Manville Co., H. W.

Electromagnets
Coto-Coil Co.
Elec. Controller & Mfg. Co.
Ohio Electric & Controller Co.
Ward Leonard Elec. Co.

Engineers, Consulting and Contr. (See Directory of Engineers.)

Engines, Gas and Gasoline
Allis-Chalmers Mfg. Co.
Worthington Pump & Machy. Corp.

Engines, Oil
Bush-Sulzer Bros.-Diesel Eng. Co.
Chicago Pneumatic Tool Co.
McIntosh & Seymour Corp.
Worthington Pump & Machy. Corp.

Engines, Steam
Allis-Chalmers Mfg. Co.
Ridgway Dynamo & Eng. Co.

Excavating Machinery Motor-Driven
Hayward Co.

Experimental Apparatus
Biddle, James G.
Leeds & Northrup Co.
Roller-Smith Co.

Evaporators, Water
Griscom-Russell Co.

Fan Motors
Adams-Bagnall Electric Co.
Century Elec. Co.
Colonial Fan & Motor Co.
Diehl Mfg. Co.
Emerson Elec. Mfg. Co.
General Electric Co.
Peerless Electric Co.
Robbins & Myers Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Fans (Exhaust and Ventilating)
Adams-Bagnall Electric Co.
Diehl Mfg. Co.
Emerson Elec. Mfg. Co.
General Electric Co.
Kimble Electric Co.
Mechanical Appliance Co.
Robbins & Myers Co.
Westinghouse Elec. & Mfg. Co.

Fans, Turbine Driven
Terry Steam Turbine Co.

Fault Finders, Cable
Matthews & Bro., Inc., W. N.

Feed Water Heaters
Elliott Co.
Griscom-Russell Co.

Fibre
American Vul. Fibre Co.
Continental Fibre Co.
Diamond State Fibre Co.
Fibre Conduit Co.
National Fibre & ns. Co.
Schoonmaker Co., A. O.
Wilmington Fibre Spec. Co.

Filters, Oil
Elliott Co.
Scaife & Sons, W. B.

Filters, Water
Elliott Co.
Griscom-Russell Co.

Fire Alarms
Ostrander & Co., W. R.

Fire Extinguishers
Johns-Manville Co., H. W.

Fire Extinguishers, Liquid for
Castle, Inc., Jas. M.

Fixture Holder, Adjustable
Matthews & Bro., Inc., W. N.

Fixtures, Adjustable Lighting
American Fixture Co.

Fixtures, Electric and Gas
Adams-Bagnall Electric Co.
American Fixture Co.

Flooring, Grating
Irving Iron Wks. Co.

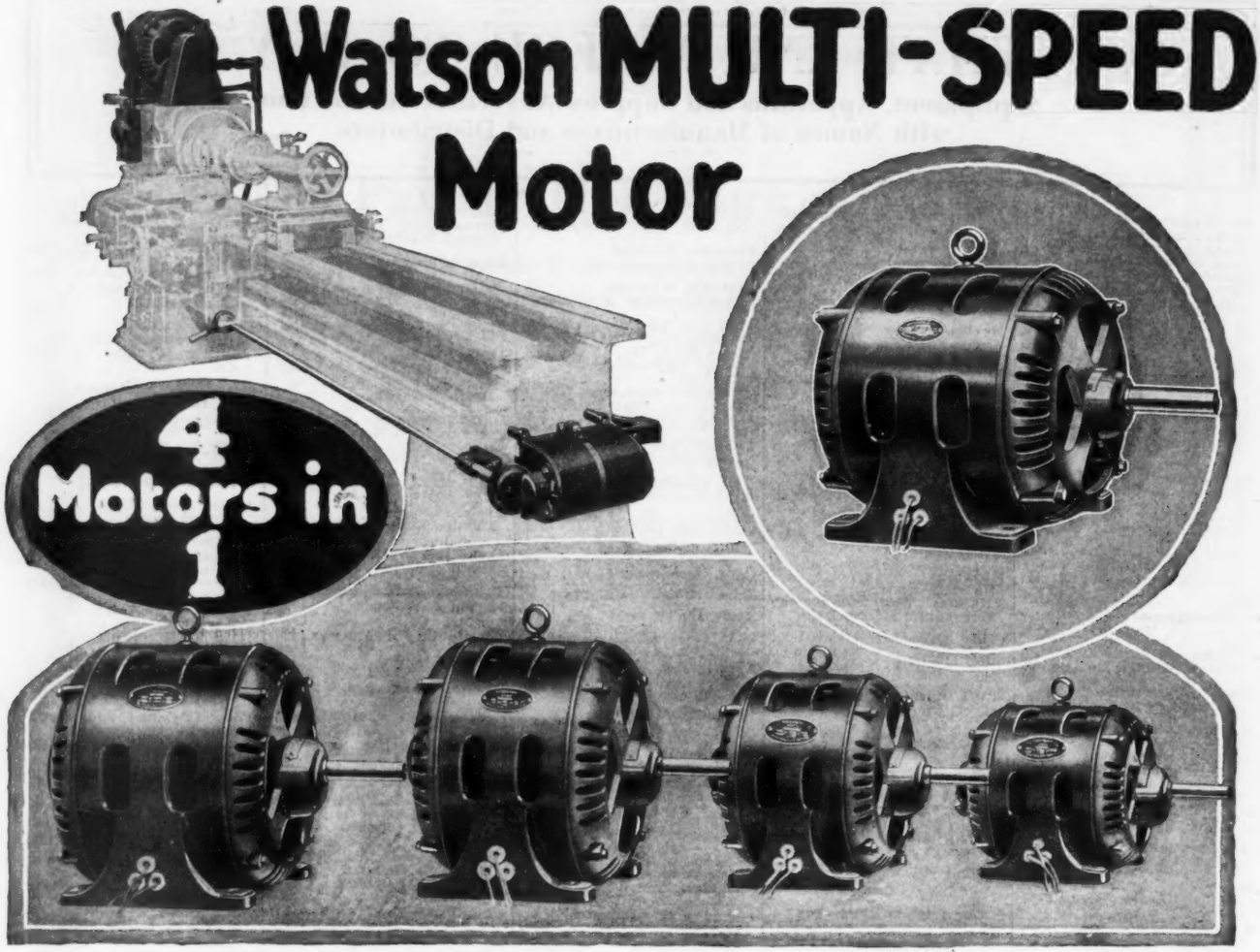
Flooring, Metallic
Irving Iron Wks. Co.

Friction Tape and Cloths
Johns-Manville Co., H. W.

Furnace Equip., Water Cooled
Blaw-Knox Co.

Furnaces, Elec.
Ajax Metal Co.
Detroit Electric Furnace Co.
Electric Furnace Const. Co.
Pittsburgh Electric Furnace Corp.

Watson MULTI-SPEED Motor



THE Watson Multi-Speed Motor provides a practical speed control where alternating current is used — an advantage that is obtainable in other motors only through the use of direct current.

It is really four motors built in one — a motor that has four separate, independent stator windings. Each stator can be wound to give any alternating current speed or any horse-power desired so long as the total output of the motor is not exceeded.

To appreciate what this means, imagine your machine operator with four constant speed motors, each of a different speed and horse-power, on a bench beside him. If he could then instantly mount and use any one of these motors he would get exactly the same results obtained by using the Watson 4-speed motor. With the Watson Multi-Speed motor a handy lever instantly gives the operator the speed and horse-power desired.

This motor is of the squirrel cage type, rugged, has no parts that need adjustment. It answers the same purpose on alternating current as a field control adjustable speed motor on direct current. Its speed remains practically constant regardless of load — a big advantage for machine tool drive.

In using this motor for machine tools, operator can throw the controller into reverse position and stop the machine instantly without injury to the motor — another great advantage.

The Watson Multi-Speed Motor can be built with two, three or four speeds, as desired.

Write us and let Watson Service show you how to fit this Multi-Speed Motor into your power requirements.

Mechanical Appliance Co., Milwaukee, Wis.

District Engineering Sales Offices;

Buffalo	Cleveland	Philadelphia	Atlanta	Des Moines	New York
Chicago	Detroit	Pittsburgh	Boston	High Point, N.C.	St. Louis
Cincinnati	Minneapolis	Amherst, N. S.	Burlington, Ia.	Los Angeles	Toronto

Furnaces, Pulverized Coal
Pulverized Fuel Equip. Corp.

Fuse, Plugs
Hart & Hegeman Mfg. Co.

Fuses
Chicago Fuse Mfg. Co.
Condit Electrical Mfg. Co.
D. & W. Fuse Co.
Daum, A. F.
Delta Star Electric Co.
Economy Fuse & Mfg. Co.
Electrical Engineers Equip. Co.
General Electric Co.
Johns-Manville Co., H. W.
Killark Elec. Mfg. Co.
Lewis & Roth Corp.
Metropolitan Elec. Prod. Co.
Schweitzer & Conrad, Inc.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Fuses, Refillable
Chicago Fuse Mfg. Co.
D. & W. Fuse Co.
Daum, A. F.
Economy Fuse & Mfg. Co.
Johns-Manville Co., H. W.
Killark Elec. Mfg. Co.
Monarch Refillable Fuse Co.
Moss-Schury Mfg. Co.
Multiple Elec. Products Co.

Gauges, Recording
Bristol Co.
Foxboro Co., The
Yarnall-Waring Co.

Gears
Diamond State Fibre Co.
General Electric Co.

Gears, Herringbone
Poole Eng'g & Mach. Co.

Gears, Reduction
Poole Eng'g & Mach. Co.

Gearing, Silent, Flexible
Link-Belt Company
Morse Chain Co.

Generating Sets
Universal Motor Co.
Westinghouse Elec. & Mfg. Co.

Globes, Shades, etc.
Adams-Bagnall Electric Co.

Grating, Flooring
Irving Iron Works Co.

Gratings
Irving Iron Works Co.

Grease Extractors
Elliott Co.

Grinders, Electric Valve
Black & Decker

Ground Clamps
Appleton Electric Co.
Sherman Mfg. Co., H. B.

Grounds, etc.
Paragon Electric Co.

Guards, Inc. Lamp
Hubbell, Inc., Harvey
Matthews & Bro., Inc., W. N.

Hair Dryers
Shelton Elec. Co.

Hangers, Cable
Condit Electrical Mfg. Co.
Hubbard & Co.

Hangers Catenary
International Nickel Co.

Harding, Case Hardening and Tempering
Hartford Mach. Screw Co.

Heaters, Air Electric
Cutler-Hammer Mfg. Co.

Heaters, Industrial, Electric
Cutler-Hammer Mfg. Co.

Heaters, Liquid, Electric
Aetna Electric App. Co.
Cutler-Hammer Mfg. Co.
Hotwat Distributing Co.

Heating Devices, Electric
Edison Elec. App. Co.
General Electric Co.
Simplex E'ec. Heating Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Hoists, Electric and Steam
Allis-Chalmers Mfg. Co.
Link-Belt Company

Indicators, Sight Flow
Richardson-Phenix Co.

Indicators, Speed
Biddle, Jaes G.
Roller-Smith Co.

Industrial Engines
Knoeppel & Co., C. E.

Instrument Transformers
General Electric Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Inst. Co.

Instruments, Electrical
Graphic.
Biddle, Jaes G.
Bristol Co.
General Electric Co.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Instrument Co.
Indicating.
General Electric Co.
Jewell Elec'l Instrument Co.
Roller-Smith Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instr. Co.
Integrating.
Biddle, Jaes G.
Duncan Electric Mfg. Co.
General Electric Co.
Roller-Smith Co.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
Repairing and Testing.
Illinois Testing Laboratories
Scientific and Testing.
Biddle, James G.
National Fibre & Ins. Co.
General Electric Co.
Leeds & Northrup Co.
Metropolitan Elec. Prod. Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Instrument Co.

Insulating Cement
Condensite Co. of America

Insulating Machinery
American Ins. Machinery Co.
New England Butt Co.

Insulating Material
China and Porcelain.
Imperial Porcelain Works
Jeffery-Dewitt Co.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.
Thomas & Sons Co., R.
Compounds, Paints and Varnishes.
Condensite Co. of America
Formica Insulation Co.
Garfield Mfg. Co.
General Bakelite Co.
Habirshaw Elec. Cable Co.
Mica Insulator Co.
Redmanol Chem. Prod. Co.
Standard Paint Co.
Westinghouse Elec. & Mfg. Co.
Comp. Cloth and Paper.
Mica Insulator Co.
Westinghouse Elec. & Mfg. Co.
Fibre.
American Vulc. Fibre Co.
Continental Fibre Co.
Diamond State Fibre Co.
Lava.
American Lava Co.
Steward Mfg. Co., D. M.
Mica.
Mica Insulator Co.

Slate
Structural Slate Co.
Tape.
Freydberg Bros.
Mica Insulator Co.
Mitchell-Rand Mfg. Co.
New York Ins. Wire Co.
Okonite Co.
U. S. Rubber Co.
Westinghouse Elec. & Mfg. Co.

Insulating Paper
Diamond State Fibre Co.
Johns-Manville Co., H. W.
National Tibre & ns. Co.

Insulator Pins
Hubbard & Co.
Thomas & Sons Co., R.

Insulators
China, Porcelain and Composition
De La Rue, Thomas
General Insulator Co.
Imperial Porcelain Works
Jeffrey-Dewitt Co.
Lapp Insulator Co., Inc.
Lewis & Roth Corp.
Locke Insulator Mfg. Co.
Mica Insulator Co.
Thomas & Sons Co., R.

Westinghouse Elec. & Mfg. Co.
Glass.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.
Post Type.
Delta Star Electric Co.

Irons, Electric
Cutler-Hammer Mfg. Co.
Simplex Elec. Heating Co.

Lamp, Guards
Hubbell Inc., Harvey
McGill Mfg. Co.
Matthews & Bro., Inc., W.N.

Lamp Replacers
Matthews & Bro., Inc., W. N.

Lamps, Arc
Adams-Bagnall Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Flaming Arc
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Incandescent
Boston Economy Lamp Div.
Chicago Electric Lamp Co.
Consolidated Elec. Lamp Co.
General Electric Co.
Western Elec. Co.
Whitelite Electric Co.

Lamps, Miniature, Inc.
General Electric Co.

Lathes
Barnes Co., W. F. & John

Lightning Arresters
Delta Star Electric Co.
Electric Service Supplies Co.
Electrical Engineers Equip. Co.
General Elec. Co.
Hubbard & Co.
Lewis & Roth Corp.
Pacific Electric Mfg. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Line Material
Anderson Mfg. Co., A. & J. M.
Archbold-Brady Co.
Electric Service Supplies Co.
General Electric Co.
Hubbard & Co.
Johns-Manville Co., H. W.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Linemen's Shields
Matthews & Bro., Inc., W. N.

Lubricating Oils
Texas. Co.

Lugs
Lewis & Roth Corp.
Sherman Mfg. Co., H. B.

Machines, Armature, Notching
Ferracute Machine Co.

Machines, Wire Tapping
Bush Electric Co.

Magnet Wire
American Brass Co.
American Electrical Works
American Steel & Wire Co.
Ansonia Elec. Co.
Belden Mfg. Co.
Benedict & Burnham Mfg. Co.
Dudlo Mfg. Co.
Hazard Mfg. Co.
Mass. Electric Mfg. Co.
Roebling's Sons Co., J. A.
Rome Wire Co.
Western Electric Co.

Magnets
Coto-Coil Co.
Cutler-Hammer Mfg. Co.
Dudlo Mfg. Co.

Magnets, Lifting
Cutler-Hammer Mfg. Co.
Elec. Controller & Mfg. Co.
Ohio E'ec. & Controller Co.

Magnets, Permanent
Stromberg-Carlson Tel. Mfg. Co.

Manganin
Baker & Co., Inc.

Mechanical Stokers
American Engr'g. Co.
Combustion Eng'g Co.
Riley Stoker Co., Ltd., Sanford
Underfeed Stoker Co.
Westinghouse Elec. & Mfg. Co.

Metal Work, Drawn and Stamped
Risdon Tool & Mach. Co.

Meter Testers
States Company
Westinghouse Elec. & Mfg. Co.

Meters, Electric (See Instruments)

Meters, Flow
General Elec. Co.
Republic Flow Meters
Spray Engineering Co.
Yarnall-Waring Co.

Meters, Gas and Air
Cutler-Hammer Mfg. Co.

Meters, Hot Water
Worthington Pump & Machy. Corp.

Mica
Chicago Mica Co.
Mica Insulator Co.
Schoonmaker Co., A. O.

Mining Machinery
Allis-Chalmers Mfg. Co.
Worthington Pump & Machy. Corp.

Molded Insulation
Condensite Co. of America
Formica Insulation Co.
Garfield Mfg. Co.
General Bakelite Co.
International Insulating Corp.
Johns-Manville Co., H. W.
Mack Molding Co.
Northern Industrial Chemical Co.
Redmanol Chem. Prod. Co.

Molded Parts
Belden Mfg. Co.
Condensite Co. of America

Monel Metal
International Nickel Co.

Molding, Metal
National Metal Molding Co.

Motors
(See Dynamos and Motors)

Nameplates
D. & G. Dial Enameling Co.

Nickel Alloys
International Nickel Co.

Nozzles, Spray
Spray Engrg. Co.
Star Brass Works

Oil Separators and Purifiers
De Laval Separator Co.

Oil Transformer
Texas Co.

Oiling Systems, Steam Turbine
Richardson-Phenix Co.

Oils, Lubricating
Texas Co.

Packing
Johns-Manville Co., H. W.

Panel Boards
Adams-Bagnall Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Panels, Switchboard
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Pencils, Drafting
American Lead Pencil Co.

Photometric Apparatus.
Elec'l Testing Laboratories.
Leeds & Northrup Co.

Pipe Frame Fittings, Electrical.
Erie Electrical Equipment Co.
Lewis & Roth Corp.

Pipe Wood.
Continental Pipe Mfg. Co.

Plate Work.
Blaw-Knox Co.

Platinum.
Baker & Co., Inc.

Plugs
Condit Electrical Mfg. Co.
Cutler-Hammer Mfg. Co.
Delta Star Electric Co.
General Electric Co.
Hubbell, Inc., Harvey.
National Metal Molding Co.

Plugs, Attachment
Hart & Hegeman Mfg. Co.

Pole Erectors
Matthews & Bro., Inc., W. N

Pole Line Hardware.
Hubbard & Co.
Western Elec. Co.

Poles, Brackets, Pins, Etc.
Western Elec. Co.

Poles, Cedar
Northern White Cedar Ass'n

Poles, Reinforcing.
Hubbard & Co.

Poles, Steel.
Archbold-Brady Co.
Bates Exp. Steel Truss Co.
Blaw-Knox Co.
Milliken Bros. Mfg. Co.

Potentiometers.
Biddle, James G.
General Electric Co.
Leeds & Northrup Co.

Potheads.
Okonite Co., The.
Lewis & Roth Corp.
Northeastern Co., The

Pots, Electric Melting
Cutler-Hammer Mfg. Co.

Presses, Cutting
Ferracute Machine Co.

Projectors, Floodlighting.
Elec. Service Supplies Co.

Protective Devices.
Condit Electrical Mfg. Co.
General Electric Co.
Lewis & Roth Corp.
Metropolitan Elec. Prod. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Pulverized Fuel Equipment
Pulverized Fuel Equip. Corp.

Pumps, Air.
Wheeler Condenser & Eng'g Co.
Worthington Pump & Mchy. Corp.

Pumps, Centrifugal.
Allis-Chalmers Mfg. Co.
Goulds Mfg. Co.
Manistee Iron Works
Pelton Water Wheel Co.
Terry Steam Turbine Co
Wheeler Condenser & Eng Co.
Worthington Pump & Mach'y Corp.

Pumps, Deep Well
Worthington Pump & Mach'y Corp.

Pumps, Elec. Garage
Hartford Mach. Screw Co.

Pumps, House Service
Goulds Mfg. Co.
Worthington Pump & Mach'y Corp.

Pumps, Hydraulic
Worthington Pump & Mach'y Corp.

Pumps, Motor Driven.
Goulds Mfg. Co.
Worthington Pump & Mach'y Corp.

Pumps, Oil
Goulds Mfg. Co.
Worthington Pump & Mach'y Corp.

Pumps, Power
Worthington Pump & Mach'y Corp.

Pumps, Steam Driven.
Allis-Chalmers Mfg. Co.
Terry Steam Turbine Co.
Worthington Pump & Mach'y Corp.

Pumps, Turbine Driven.
Terry Steam Turbine Co.

Pumps, Vacuum
Worthington Pump & Mach'y Corp.

Pumps, Waterworks
Allis-Chalmers Mfg. Co.
Goulds Mfg. Co.
Terry Steam Turbine Co.

Pyrometers.
Bristol Co., The.
Leeds & Northrup Co.

Radio Laboratory Apparatus
General Radio Co.

Rail Bonds.
American Steel & Wire Co.
Condit Electrical Mfg. Co.

Ranges, Elec.
Edison Elec. App. Co.
Estate Stove Co.
General Electric Co.
Simplex Elec. Heating Co.
Westinghouse Elec. & Mfg. Co.

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Over twenty-eight years' experience in design and proper materials, makes Wagner Transformers as good as can be built.

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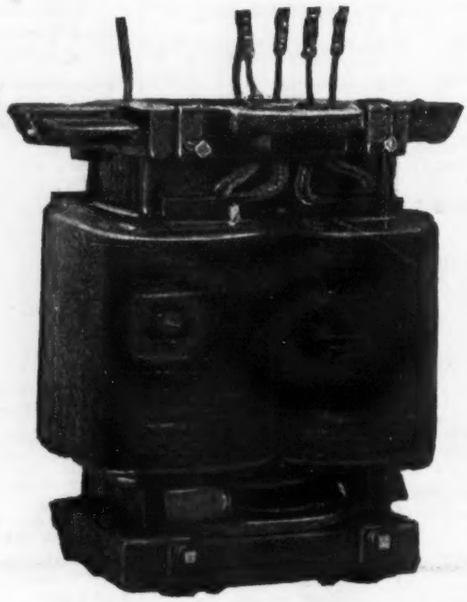

Coil and Core Assembly of Wagner Distribution Transformer

WAGNER ELECTRIC MANFG. COMPANY
Wagner Quality
SAINT LOUIS, U.S.A.

572

Rectifiers
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Reflectors
Adams-Bagnall Electric Co.

Repairing
(See Searchlight Section)
Cleveland Armature Works

Resistance Units.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Electric Products Co.
General Electric Co.
Industrial Controller Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Rheostats.
Beck Bros.
Biddle, Jaes G.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Monitor Controller Co.
Sundh Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Rosettes.
Hart & Hegeman Mfg. Co.
National Metal Molding Co.

Screens, Intake, Water Traveling
Link-Belt Company

Screw Machine Products
Hartford Machine Scvrew Co.

Searchlights.
General Electric Co.

Second-Hand Apparatus.
(See Searchlight Section)
Archer & Baldwin, Inc.
Brew, Wm. P.
Brown-Hunkele Corp.
Carrell & Co., W. A.
Chicago Elec. Constr. Co.
Chuse Engine Co., H. A. & G. X.
Cleveland Armature Wks., Inc.
Consolidated Gas, Elec. Lt. & Power Co.
Davis, J. F.
Davis Machine & Motor Co., Inc.
Duquesne Elec. & Mfg. Co.
Elec. Motor & Repair Co.
Goodrich Co., B. F.
Greenfield Elec. Lt. & Pr. Co.
Gregory Elec. Co.
Guaranteed Motor Co.
Harris Bros. Co.
Holcomb, D. S.
Independent Electric Machinery Co.
Klein & Co., Nathan.
MacGovern & Co.
McMillan, A.
Miller Owen Elec. Co.
Myerson, Joseph.
Power Equip. Co.
Power Machinery Exchange.
Randle Machinery Co.
Reliable Electric Motor Co.
Ross Power Equip. Co.
Sachsenmaier Co., Geo.
Scheinert & Co., R.
Schwartz & Land.
Standard Elec. & Elev. Co.
Stewart & Co., Paul
Thompson, Henry P.
Tiffany Hall & Co.
Toomey, Inc., Frank.
Venino Bros.
Werby & Co., A.
Wilson Machy. Co., H. R.
Zelnicker Supply Co., Walter A.

Separators, Magnetic.
Cutler-Hammer Mfg. Co.

Separators, Oil
Elliott Co.
Griscom-Russell Co.

Shade Holders.
Adams-Bagnall Electric Co.
Hubbell, Inc., Harvey.

Shades, Tin
Ostrander & Co., W. R.

Sheet Metal.
Amer. Sheet & Tin Plate Co.

Sheets, Electrical.
Amer. Sheet & Tin Plate Co.

Silent Chain Drives
Link-Belt Company

Sockets & Receptacles
Appleton Electric Co.
Cutler-Hammer Co.
General Electric Co.
Hart & Hegeman Mfg. Co.
Hubbell, Inc., Harvey.
National Metal Molding Co.
Ostrander & Co., W. R.
Siemon Hard Rubber Co.

Solder
Chicago Solder Co.

Soldering Flux
Blake Signal & Mfg. Co.

Soldering Irons
Cutler-Hammer Mfg. Co.

Solenoids.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Ward-Leonard Elec. Co.

Springs.
American Steel & Wire Co.
Cary Spring Works.

Sprockets, Silent Chain.
Link-Belt Company
Morse Chain Co.

Stage Lighting Apparatus
Condit Electrical Mfg. Co.

Staples.
American Steel & Wire Co.
Blake Signal & Mfg. Co.

Starters, Motor.
Condit Electrical Mfg. Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Sundh Electric Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.

Steam Specialties.
Power Specialty Co.

Stokers.
American Engr'g. Co.
Combustion Eng'g Co.
Green Eng'g Co.
Riley Stoker Co., Ltd.
Sanford
Underfeed Stoker Co.
Westinghouse Elec. & Mfg. Co.

Stokers, Pulverized Coal.
Pulverized Fuel Equip. Co.

Storage Battery Casings
International Nickel Co.

Stoves, Electric. (See Ranges, Etc.)

Structural Steel.
Blaw-Knox Co.
Milliken Bros. Mfg. Co.

Sub-Stations, Outdoor.
Delta Star Electric Co.
Elec. Engineers Equip. Co.
General Electric Co.
Lewis & Roth Corp.
Westinghouse Elec. & Mfg. Co.

Superheaters, Steam.
Power Specialty Co.
Locomotive Superheater Co.

Supplies (Electric Railway).
General Electric Co.
Johns-Manville Co., H. W.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Supplies, Electrical.
General Electric Co.
Manhattan Elec'l Supply Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Switchboard Supplies.
Condit Electrical Mfg. Co.
Erie Electrical Equipment Co.
General Electric Co.
Lewis & Roth Corp.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.

Switchboards.
Adam Electric Co., Frank
Allis-Chalmers Mfg. Co.
Anderson Mfg. Co., A. & J. M.
Condit Electrical Mfg. Co.
General Electric Co.
Roller-Smith Co.
Trumbull Elec. Mfg. Co.
Wagner Elec Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Automatic Time.
Anderson Mfg. Co., A. & J. M.
General Electric Co.
Matthews & Bro., Inc., W. N.
Westinghouse Elec. & Mfg. Co.

Switches, Disconnecting.
Anderson Mfg. Co., A. & J. M.
Delta Star Electric Co.
Elec'l Engineers Equip. Co.
General Electric Co.
Lewis & Roth Corp.
Matthews & Bro., Inc., W. N.
Pacific Electric Mfg. Co.
Schweitzer & Conrad, Inc.
Trumbull Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Switches Enclosed.
General Electric Co.
Hart-Hegeman Mfg. Co.
Trumbull Electric Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Float.
Cutler-Hammer Mfg. Co.
General Elec. Co.
Sundh Elec. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Fuse.
General Electric Co.
Matthews & Bro., Inc., W. N.
Metropolitan Elec. Prod. Co.

Switches, Knife.
Anderson Mfg. Co., A. & J. M.
Condit Electrical Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Trumbull-Vanderpoel Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Oil
Condit Electrical Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches, Pole Top.
Condit Electrical Mfg. Co.
Delta-Star Elec. Co.
Electrical Engineers Equipment Co.
General Electric Co.
Lewis & Roth Corp.
Pacific Electric Mfg. Co.

Switches, Remote Control.
Anderson Mfg. Co., A. & J. M.
Cutler-Hammer Mfg. Co.
General Electric Co.
Sundh Elec. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Safety
General Electric Co.
Trumbull Electric Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Series.
General Electric Co.

Switches, Snap and Push Button.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hart & Hegeman Mfg. Co.
Western Electric Co.

Switches, Time
General Electric Co.
Matthews & Bro., Inc., W. N.
Paragon Electric Co.

Synchroscopes
Westinghouse Elec. & Mfg. Co.
Weston Electrical Instrument Co.

Tachometers.
Biddle, James G.
Bristol Co., The.
Foxboro Co., The
Johns-Manville Co., H. W.
Roller-Smith Co.

Taps and Dies.
Carpenter T. & D. Co., J. M.

Telephones.
Holtzer-Cabot Elec. Co.
Stromberg-Carlson Tel. Mfg. Co.
Western Elec. Co.

Testing Apparatus.
American Transformer Co.
Biddle, James G.
Leeds & Northrup Co.
Roller-Smith Co.
States Co.
Westinghouse Elec. & Mfg. Co.

Wire Resistance
International Nickel Co.

Wood Pipe.
Continental Pipe Mfg. Co.

Wood Preservatives.
Northeastern Co.

X-Ray Apparatus.
General Electric Co.

Theatre Dimmers.
Cutler-Hammer Mfg. Co.
General Electric Co.
Industrial Controller Co.
Ward Leonard Electric Co.

Thermometers.
Bristol Co., The
Foxboro Co., The
Taylor Instrument Companies.

Tools, Construction
Oshkosh Mfg. Co.

Tools, Linemen's.
Bush Electric Co.
Western Elec. Co.

Tools, Portable Electric
Black & Decker
Chicago Pneumatic Co.

Towers, Radio.
Blaw-Knox Co.
Milliken Bros. Mfg. Co., Inc.

Towers, Transmission.
Archbold-Brady Co.
Bates Evp. Steel Truss Co.
Blaw-Knox Co.
Coombs & Co., R. D.
Milliken Bros. Mfg. Co., Inc.

Transformers.
Acme Apparatus Co.
Adams-Bagnall Electric
Allis-Chalmers Mfg. Co.
American Transformer Co.
Duncan Elec. Mfg. Co.
General Electric Co.
Kuhlman Electric Co.
Metropolitan Elect. Prod. Co.
Moloney Electric Co.
Pittsburgh Transformer Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Transformers, Bell Ringing
Pittsburgh Transformer Co.
Westinghouse Elec. & Mfg. Co.

Transmission, Silent Chain
Link-Belt Company
Morse Chain Co.

Traps, Steam
Elliott Co.

Treads, Ladder and Stair, Non-Slipping
Irving Iron Works Co.

Tube Cleaners
Yarnall-Waring Co.

Turbines, Hydraulic.
Allis-Chalmers Mfg. Co.
Leffel & Co., James
Pelton Water Wheel Co.
Smith S. Morgan Co.
Trump Mfg. Co.

Turbines, Steam.
Allis-Chalmers Mfg. Co.
General Electric Co.
Ridgeway Dynamo & Eng. Co.
Westinghouse Elec. & Mfg. Co.
Terry Steam Turbine Co.

Turbo-Generators.
Allis-Chalmers Mfg. Co.
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.

Vacuum Cleaners, Electric.
Hoover Suction Sweeper Co.
Western Elec. Co.

Valves.
Elliott Co.
Nelson Valve Co.

Valves Blow-Off
Yarnall-Waring Co.

Valves Trim.
International Nickel Co.

Valves, Superheated Steam.
International Nickel Co.
Nelson Valve Co.

Varnishes.
Garfield Mfg. Co.

Vibrators.
Shelton Elec. Co.

Washers.
Massachusetts Machine Shop.

Washing Machines, Electric
General Railway Signal Mfg. Co.
Nineteen Hundred Washer Co.
Western Elec. Co.

Watches, Stop
Diddisheim Co., Inc., Hipp.

Waterproofing Materials.
Johns-Manville Co., H. W.
Mitchell-Rand Mfg. Co.

Water Heaters, Electric
Aetna Electric App. Co.
Electric Heating & Mfg. Co.
Hotwat Distributing Co.
Nineteen Hundreed Washer Co.

Water Purifying Apparatus.
Griscom-Russell Co.
Permutit Co.
Yarnall-Waring Co.

Water Softening Apparatus.
Permutit Co.
Scaife & Sons, W. B.
Yarnall-Waring Co.

Water Wheel Governors.
Pelton Water Wheel Co.
Woodward Governor Co.

Water Wheels, Impulse Turbines.
Allis-Chalmers Mfg. Co.
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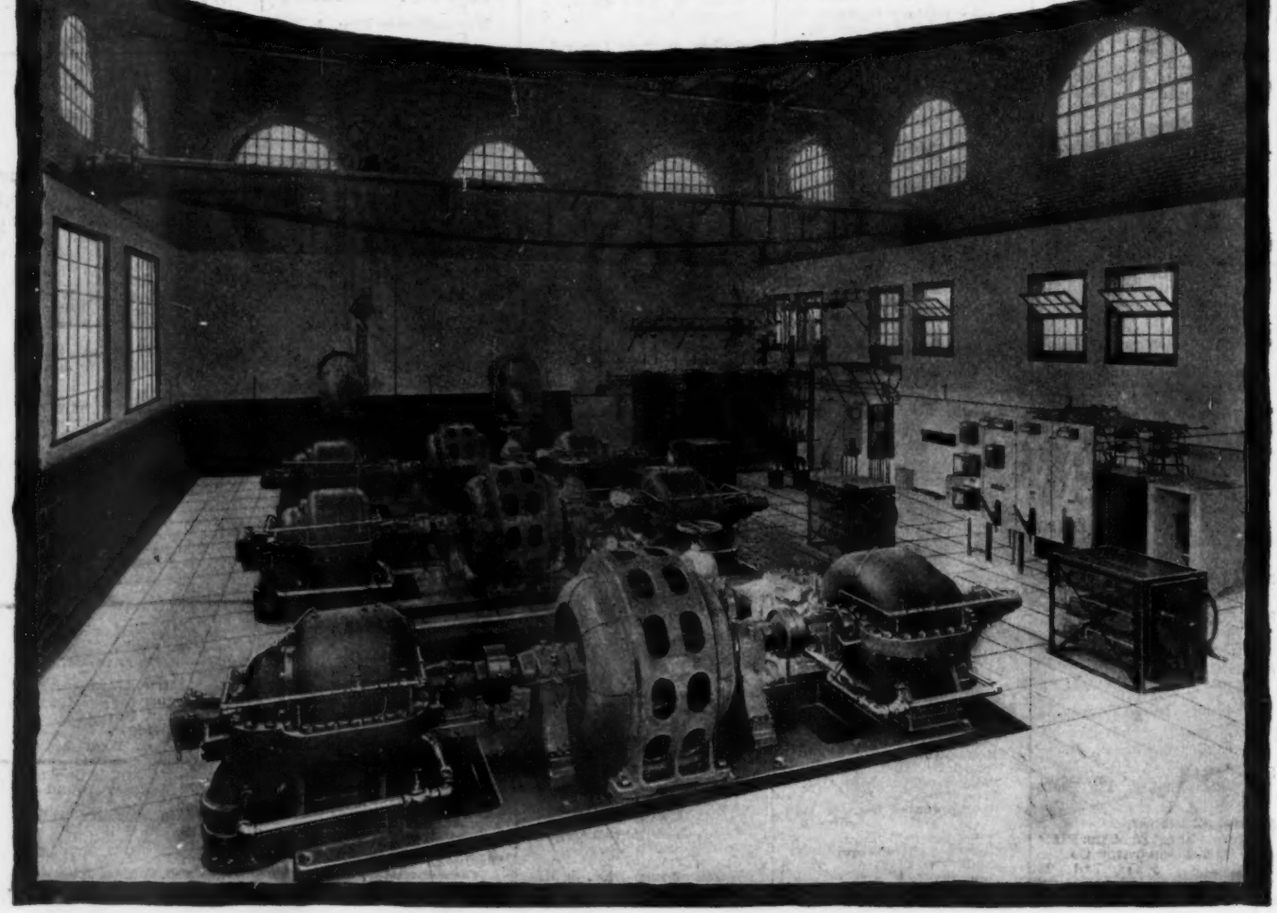

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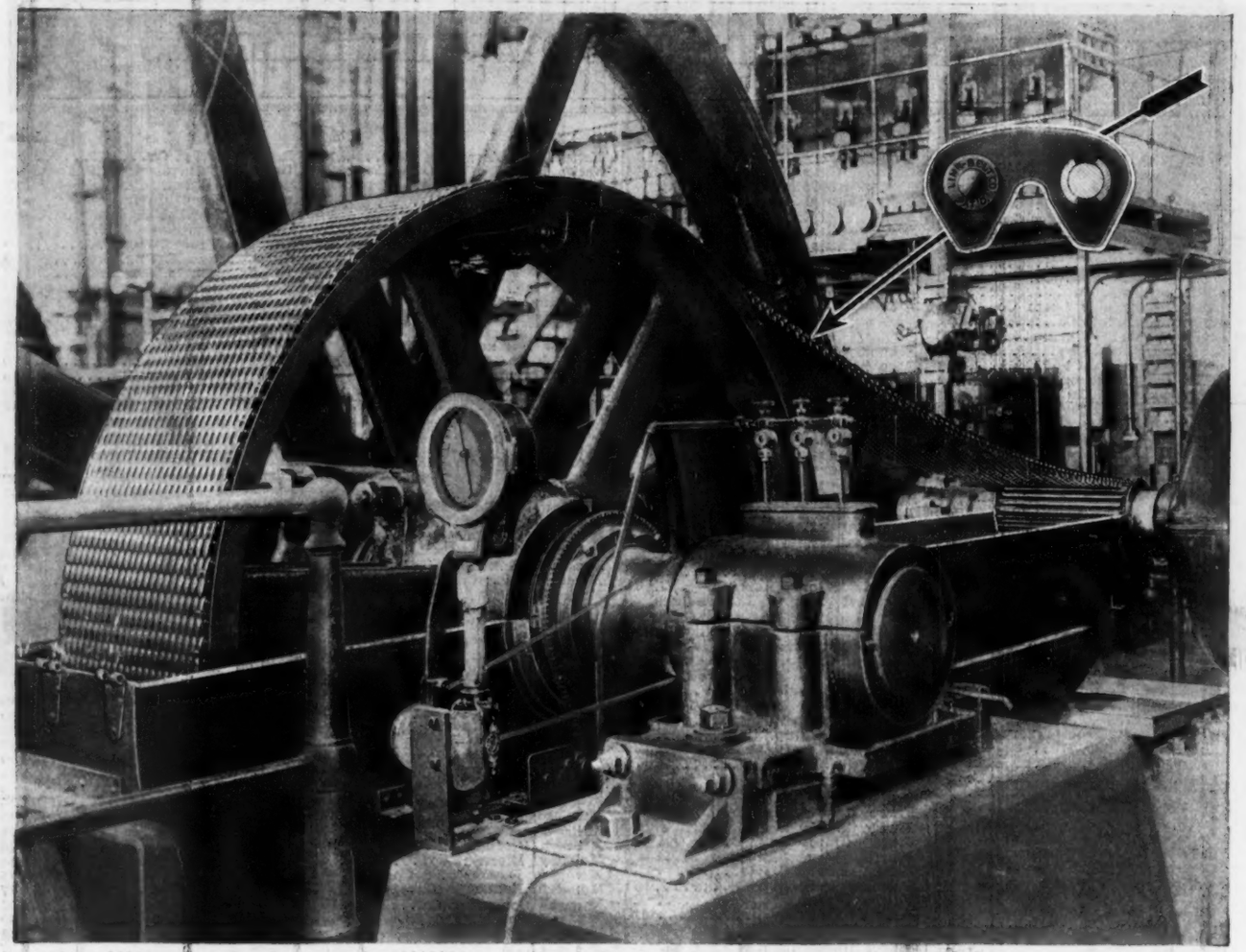

MODERN Science believes that, some day, Industry will draw its power directly from the sun. Science is probably right. But, in the meantime—

Business Science has to solve immediate problems, as, for instance, the problem of efficient and economical transmission, by mechanical means, of power developed by mechanical means.

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It operates smoothly, surely, at the highest speeds. It is steel-encased, protected from dust, and safeguarding workmen, and is lubricated by a constant oil bath.

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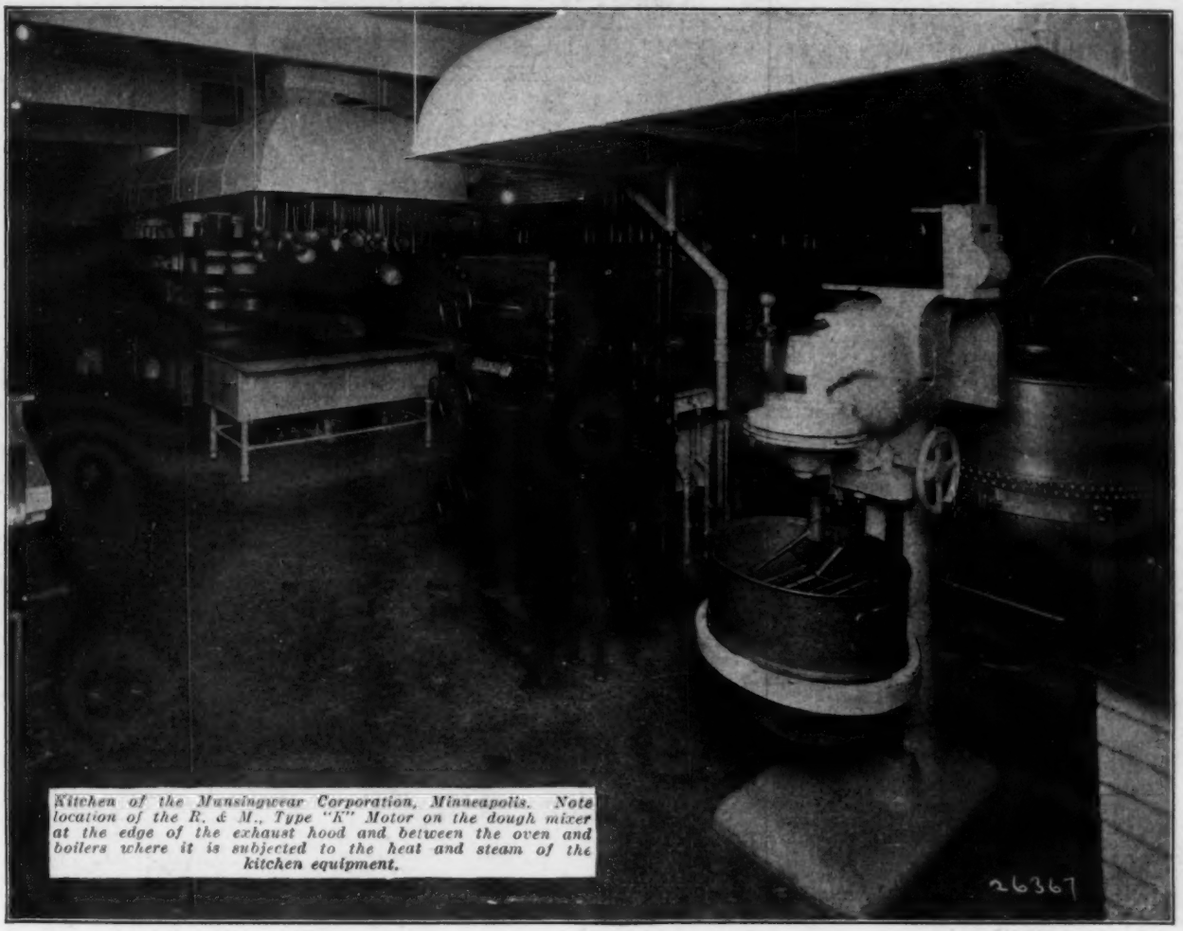

Kitchen of the Munsingwear Corporation, Minneapolis. Note location of the R. & M., Type "K" Motor on the dough mixer at the edge of the exhaust hood and between the oven and boilers where it is subjected to the heat and steam of the kitchen equipment.

Where Service Conditions are Severe Type "K" Reliability Shows at Its Best

Heat, steam, greasy vapors and other conditions ordinarily considered detrimental to the best motor service, when motors of the open type are used, have but little effect upon the reliable operation of the R & M Type "K" induction motor.

Type "K" motors are liberally designed and will operate at safe temperatures in heated atmosphere. The bearings are thoroughly protected and the windings are moisture-proof.

Manufacturers of motor-equipped machines which must operate in hot, moist and dusty atmosphere, rely upon type "K" to insure dependable service for their machines.

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INSTRUMENTS
For
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Provide an efficient check on important operations

Bulletin AC-121 briefly describes the Recording Gauges

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Thief Proof

Matthews' Hold-fast Guards are clamped rigidly to the lamp socket. The design of the collar is such that once the set screw is tightened up and bent, it cannot be easily removed and lost or damaged. This permanently locks the guard to the socket.

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THE ANSONIA ELECTRICAL CO.
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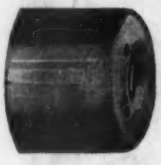

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Furnish continuous records of current on generator and feeder panels, showing approach of peak loads. These instruments are extremely simple and rugged in construction. They are furnished with uniform scale charts for both A.C. and D.C.

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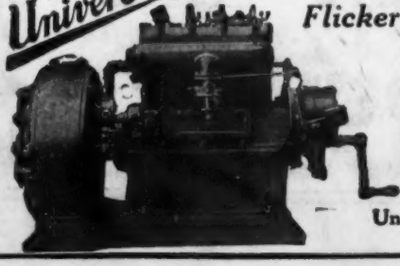

lighting of residences, small towns or boats; battery charging; moving picture projection; wireless, etc.—1 K.W., 60 or 110 volt set illustrated.

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